

JUL 16 1941

# AUTOMOTIVE INDUSTRIES

LAND — AIR — WATER

JULY 15, 1941



TO MAKE  
**TIMKEN**  
BEARING ROLLS  
BETTER THAN EVER

The machine pictured above permits fast, accurate visual inspection of TIMKEN Bearing rolls for mechanical and handling defects *without* the rolls being touched by the inspector.

"Not touched by human hands", a familiar slogan in the food industry, doesn't seem to be a point worth mentioning for an industrial product. It is, nevertheless.

Because TIMKEN Bearing rolls are made of case carburized alloy steel, salt solutions always present on human hands will tarnish them unless protected by a film of oil. Since this new machine eliminates roll-hand contact, rolls may be thoroughly washed free of oil

before inspection without danger of product spoilage. Thus the inspector is not handicapped by any oil film in this inspection operation — one of the most exacting in the anti-friction bearing industry.

Large numbers of these machines are already installed and more will be placed in service as soon as available in both Canton and Columbus plants of THE TIMKEN ROLLER BEARING COMPANY.

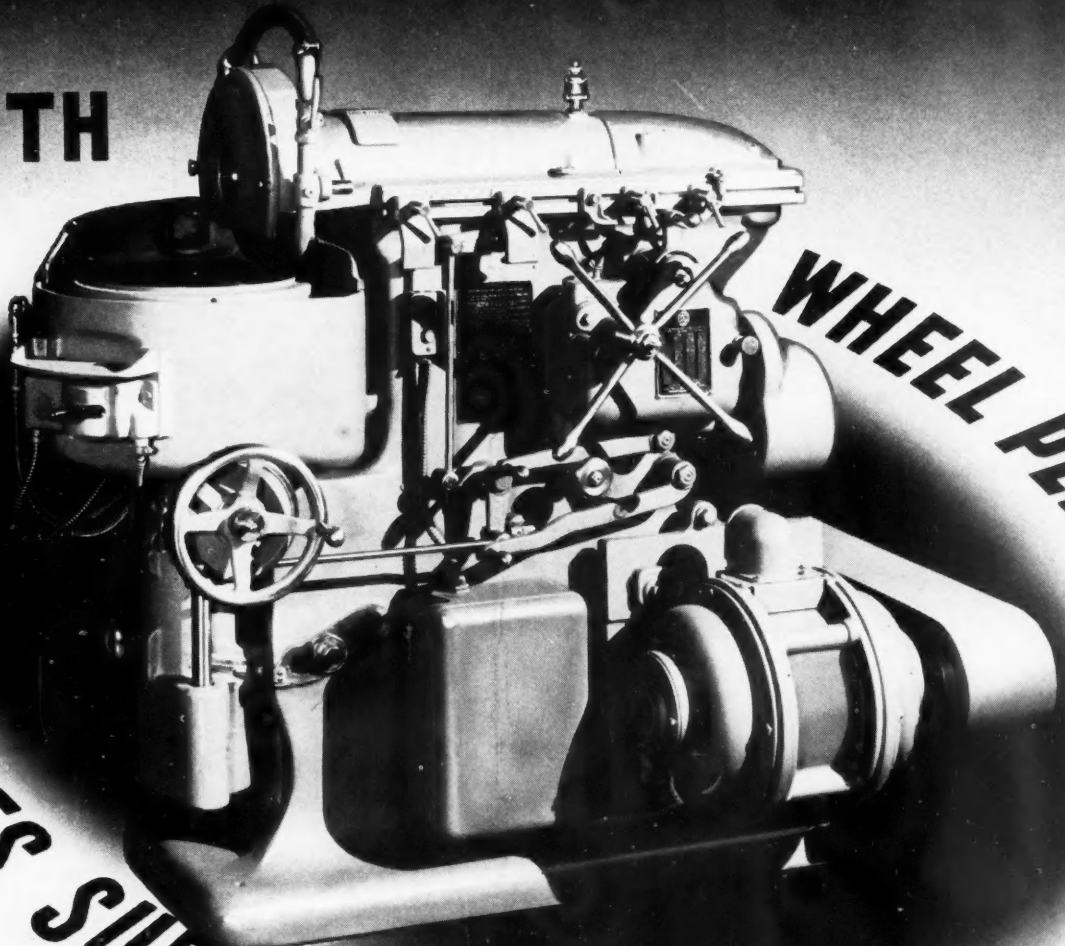
**TIMKEN**  
TAPERED ROLLER BEARINGS



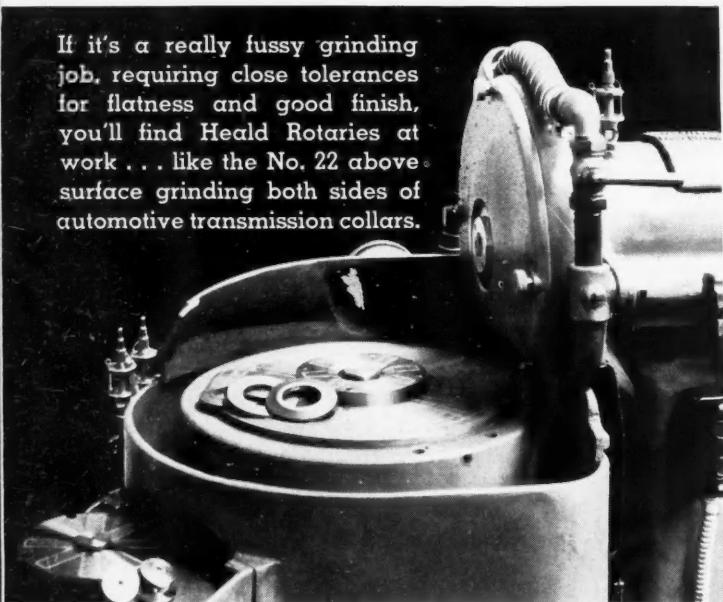
# SURFACE GRINDING

WITH

• PRODUCES SUPERIOR CONCENTRIC FINISH • WHEEL PERIPHERY •



If it's a really fussy grinding job, requiring close tolerances for flatness and good finish, you'll find Heald Rotaries at work . . . like the No. 22 above surface grinding both sides of automotive transmission collars.



On Heald Rotary Surface Grinding Machines you grind with the wheel periphery . . . which means you get extremely accurate plane surfaces because you actually generate them. Grinding wheel and work rotate at  $90^\circ$  to each other with the wheel reciprocating radially . . . and this means you get a highly desirable concentric finish. Both reasons together are good reasons why Heald Rotaries have become the standard of industry the last 30 years for surface grinding operations. Built in two styles to exactly suit your requirements . . . the No. 22 and the No. 25A with chuck capacity from 8" up to 30" diameter. These machines will grind parallel, concave and convex. Both machines will give you a new conception of surface accuracy. Complete information and specifications gladly sent on your request.

**THE HEALD MACHINE COMPANY, Worcester, Mass.**

# AUTOMOTIVE INDUSTRIES

## AUTOMOBILE

Reg. U. S. Pat. Off.  
Published Semi-Monthly

Volume 85

Number 2

JULIAN CHASE, Directing Editor  
F. M. HELDT, Engineering Editor JOS. GESCHELIN, Detroit Technical Editor  
J. B. CUSTER, Ass't Editor JEROME H. FARRIS, Ass't Editor  
E. L. WARNER, JR., Detroit News Editor HOWARD KOHLBRENNER, Art Editor  
L. W. MOFFETT, Washington News Editor J. G. ELLIS, Washington News Editor  
MARCUS AINSWORTH, Statistician

### CONTENTS

Down With Non-Essential, Non-Defense Government Spending. <i>By Julian Chase</i>	19
Airplane Wheels and Brakes by the Thousand. <i>By Joseph Geschelin</i>	20
Testing Army Warplanes at Wright Field	24
Air-Cooled Vs. Liquid-Cooled Aircraft Engines	26
Hurricanes from Canada	28
Airbriefs	30
Explosive Rivets	31
More About the 601-A Daimler-Benz Engine	32
Photoelasticity in Automobile Engineering. <i>By Charles Lipson, Ph.D.</i>	36
What the Industry Is Doing	39
Monroe Methods in Parts Manufacture	40
Men and Machines	44
Automotive Materials	46
News of the Industry	47
Calendar of Coming Events	49
Advertisers' Index	92

Copyright 1941 by Chilton Company (Inc.)

#### Automotive Division

JOS. S. HILDRETH, President and Manager  
JULIAN CHASE, Vice Pres. G. C. BUZBY, Vice Pres.

#### OFFICES

Philadelphia—Chestnut & 56th Sts., Phone Sherwood 1424  
New York—100 East 42nd St., Phone Murray Hill 5-8600. Chicago—Room 916 London Guaranty & Accident Bldg., Phone Franklin 4243. Detroit—1015 Stephenson Bldg., Phone Madison 2090. Cleveland—609 Guardian Bldg., Phone Cherry 4188. Washington—1061 National Press Bldg., Phone District 6877. San Francisco—444 Market St., Room 305, Phone Douglas 0967. Los Angeles—6000 Miramonte Blvd., Phone Lafayette 5525.  
Cable Address.....Autoland, Philadelphia

Member of the Audit Bureau of Circulations  
Member Associated Business Papers, Inc.

Automotive Industries—The Automobile is a consolidation of the Automobile (monthly) and the Motor Review (weekly), May, 1902; Dealer and Repairman (monthly), October, 1903; the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

Owned and Published by  
**CHILTON COMPANY**  
(Incorporated)



#### Executive Offices

Chestnut and 56th Streets, Philadelphia, Pa., U. S. A.

#### Officers and Directors

C. A. MUSSELMAN, President  
Vice-Presidents

JOS. S. HILDRETH  
EVERIT B. TERHUNE

GEORGE H. GRIFFITHS  
J. H. VAN DEVENTER

C. S. BAUR

WILLIAM A. BARBER, Treasurer JOHN BLAIR MOFFETT, Secretary  
JULIAN CHASE THOMAS L. KANE G. C. BUZBY  
P. M. FAHRENDORF HARRY V. DUFFY CHARLES J. HEALE

## Do you own a cow?



If you—a city dweller—should buy a cow you would get more milk—plus a lot of expense and bother. Chances are, you'll continue to patronize the milkman.

That applies to car building too. It takes about 42,000 parts to make an automobile.

For quick, inexpensive and certain production of some of those parts, you, like the milk customers, prefer to let specialists lend a hand.

Borg and Beck specializes in clutches. Our single-minded devotion to better-

ing our one product has profited many a car builder.

Our talents are grooved to the design, production and prompt delivery of a clutch that you can install and then forget. Once in place, it actually lives the blameless and ob-

scure clutch life that motorists have learned to expect.

That's why Borg and Beck sells millions of original equipment clutches a year. It's our way of helping you give your customers their money's worth.



**BORG & BECK DIVISION**  
BORG-WARNER CORPORATION  
CHICAGO, ILLINOIS

## We Still Say What This Ad Said

TO PUT IT MILDLY, the world has seen plenty of changes since the above ad appeared back in '37.

Yet this four-year-old ad tells a story that could have been written just yesterday. It is the story of the way we do business.

In 1937 we said that our clutch was the best clutch that skill, science and workmanship could produce. We say the same today of a vastly improved and thoroughly modern product . . . and we pledge our efforts to continue the Borg & Beck policy of improvement so that the ad above will still hold true at any time in the future.

**Borg & Beck Division, Borg-Warner Corporation**

July 15, 1941

When writing to advertisers please mention Automotive Industries

3

AUTOMOTIVE INDUSTRIES, Vol. 85, No. 2. Published semi-monthly by Chilton Co., Chestnut & 56th Sts., Phila. Entered as Second-Class Matter October 1, 1925, at the Post Office at Philadelphia, Pa.; Under the Act of Congress of March 3, 1879. In Case of Non-Delivery Return Postage Guaranteed. Subscription price: United States, Mexico, United States Possessions, and all Latin-American countries, \$1.00 per year. Canadian and Foreign, \$2.00 per year; single copies, 25 cents, except Statistical Issue (Mar. 1, 1941), 50 cents.





CONTROLLED QUALITY  
**SHEETS**

*for deep drawing have a satin-smooth finish  
that stands up.*

**JONES & LAUGHLIN STEEL CORPORATION**  
AMERICAN IRON AND STEEL WORKS • PITTSBURGH, PENNSYLVANIA



## AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Volume 85 July 15, 1941 Number 2

### Quality Control Standards for Defense Contractors

Developed at the request of the War Department to help speed up production and the inspection of products for National Defense, the American Standards Association, New York City, has announced the publication of two standards—Guide for Quality Control (Z1.1-1941) and Control Chart Method of Analyzing Data (Z1.2-1941). The purpose of these standards is to serve as a guide in controlling the manufacture of products so as to maintain sufficient uniformity of quality to meet specification requirements. They are intended for use by the War Department and also by contractors and sub-contractors in keeping their products up to Government specifications. The two standards are published together in a single pamphlet, which is available at 75 cents per copy at the association's headquarters, 29 West 39th St.

### A MESSAGE TO YOU . . .

**Defense Savings Bonds and Stamps give us all a way to take a direct part in building the defenses of our country—an American way to find the billions needed for National Defense.**

**The United States is today, as it has always been, the best investment in the world. This is an opportunity for each citizen to buy a share in America.**

### Airplane Wheels and Brakes by the Thousands 20

The National Acme Co. is doing a really big job in turning out airplane wheels and brakes for the defense program. Just how they are fitting into the picture and the remarkable way in which they are meeting the national call is a story that you will want to read.

### Hurricanes from Canada 28

In this feature there are a number of pictures. In fact the story is told completely in pictures with enlightening captions. Little has been printed about airplane production in Canada. This fact and the advantage of being able to so completely cover the subject pictorially makes this presentation of special interest.

### More About the Mercedes-Benz 32

A few issues ago we printed a description of this plane. Recently some more data and more instructive pictures have been obtained so here they are to augment the earlier presentation.

### Photoelasticity in Automobile Engineering 36

Although photoelasticity began over 100 years as a study, its practical use, in the automobile field particularly, is only a recent development. It is without question an engineering means of studying stresses that should be more understood. The author of this article is well equipped to treat the subject and makes it not only interesting but instructive as well.

### Monroe Methods in Parts Manufacture 40

After manufacturing automobile equipment and parts for over 24 years it would be strange indeed if some methods of production were not developed that were unique. It is, therefore, with considerable interest that you should read this article.

# New Guide for STEEL-BUYERS

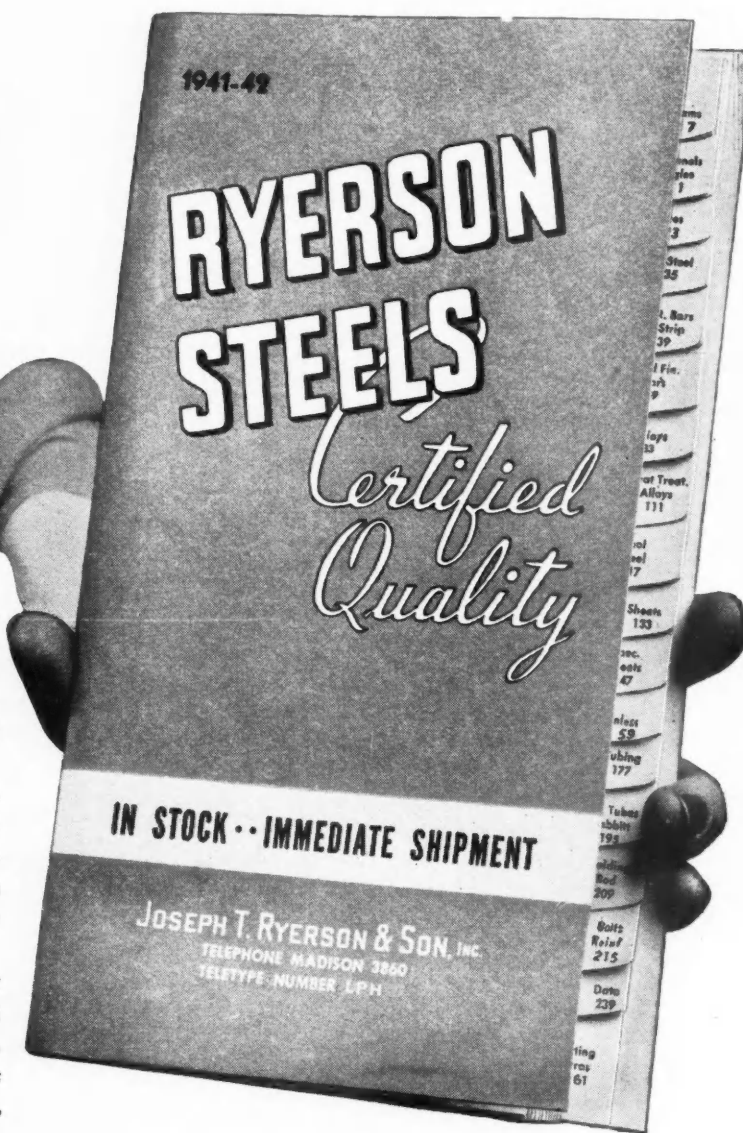


● Many new sizes and products . . . larger, easier-reading type . . . improved tab indexing . . . handy, pocket size . . . mechanical binding, and a host of other time-saving features make this new blue and grey Ryerson Stock List the most helpful guide for every steel buyer.

The wide range of Certified Steel products listed in the new Ryerson Stock List includes more than 1500 *new* kinds, shapes and sizes added to Ryerson stocks — many of them special analyses in demand for airplane construction and other exacting defense requirements.

Make this new Ryerson Stock List your guide to every steel requirement. If you have not received *your copy*, write the nearest Ryerson plant.

**Joseph T. Ryerson & Son, Inc. Steel-Service  
Plants at: Chicago, Milwaukee, St. Louis,  
Cincinnati, Detroit, Cleveland, Buffalo, Boston,  
Philadelphia, Jersey City.**



# RYERSON

**N** *Certified* **ST**



# STEELS

## Down With Non-Essential Non-Defense Government Spending

**D**URING the past week there was announced the beginning of a national movement which, because of the ends it seeks, is deserving of the vigorous support of all industry, all tax payers—of whom industry is by far the largest—all Americans who are believers in democracy. We are pointing to the campaign for the reduction of non-essential and non-defense spending by Federal, state and local governments, which has been initiated by the Citizens' Emergency Committee on Non-Defense Expenditures.

Taxes are high. They will be higher, and soon they will be higher still. Taxes of any kind are an important factor in increasing costs. Increased costs are basically responsible for higher prices. Higher prices, generally speaking, reduce sales. Reduced sales mean lower production. Lowered production means less employment. All of which is elementary but fundamental and so fundamental that no fancy theories or starry-eyed theorists can make that economic cycle stop, turn and run the other way.

All dollars spent by government, whether for anti-aircraft guns, for farmers' subsidies, for post offices in doubtful election districts, for new city halls, or for paving streets in front of ward-healers' saloons, must be paid in taxes, and taxes, so we have it on the highest authority, are paid in the sweat of the working man's brow.

These are days in which we need guns imperatively. These are days in which we do not want and must not have foolish, selfish and extravagant political spending. These are days in which politicians must be compelled to get along no better than they can without buying votes or personal favors with other people's money. That goes, and more so, for big politicians as well as for little ones. Industry has been called on, sometimes unjustly and unwisely, to suspend "business as usual." The country calls, or should call now, on all politicians not merely to suspend but to cease and desist forevermore from the wasteful and the unnecessary spending parts of their "business as usual."

We are reminded in the first news release of the Committee, whose chairman is Dr. Henry M. Wriston, president of Brown University, that in 1914 all Federal, state and local expenditures combined, amounted to about 3 billion dollars a year. By 1941 this had risen to approximately 23 billion dollars. In 1914 the Federal debt was somewhat over one billion dollars. On June 30, 1941, it was 49 billion dollars, or about \$1,500 per family. In the near future, according to estimates of government officials, it will amount to upwards of 100 billion dollars.

Doctor Wriston also reminds us that authorities have asserted, and shown how, from one to two billion dollars in yearly Federal spending can be saved. "Yet despite these pleas," he adds, "despite the emergency, despite immediate defense needs, despite the sacrifices which have been asked of the people, non-defense appropriations of the Federal Government were increased almost 90 million dollars over last year."

Much has been heard in late years about social security as a major objective of beneficent and forward-seeing government, and claims of gains in that direction have been skillfully turned by our highest placed politicians into potent political capital. But before we have social security which is really secure, we must have several other things. We must have national security against aggression and conquest. We must have a strong political economy based on a sound governmental fiscal policy. We must have hard-headed business administration of public affairs. We must impose on politics and politicians the kind of intelligently altruistic regulation which politicians, since the hatching of the New Deal particularly, have increasingly insisted that they best can impose on the country's business and business men.

Here, in this undertaking of the Citizens' Emergency Committee on Non-Defense Expenditures, is a movement that deserves enthusiastic and active support. Here is a vital national endeavor which business men, individually and collectively, better than any others, can further and effectuate.





Quality control is the most important function here. This shows the final inspection of a wheel, the operator checking bearing bore for depth at the moment

# Airplane Wheels and Brakes by



Close-up of one of a battery of Warner & Swasey turret lathes in the wheel department. This is the finish machining of the outside of a 26 in. wheel flange. Note the heavy stream of cutting fluid for cooling and washing away the chips

# the Thousands

One of several Bullard V.T.L. machines in the wheel department, this one engaged on the first operation—complete machining of the inboard end—on a 23 in. wheel. The cross-slide at the right, on the machine, forms the outside contour, using an extremely wide forming tool

Interior of the wheel assembly department, showing the brake assembly lines at the left. Brakes are being prepared for installation in the 26 in. wheels in the foreground

**A**S a part of its contribution to the national defense program, The National Acme Co., Cleveland, Ohio, is functioning as the principal contractor to the Airplane Division, Goodyear Tire and Rubber Co., for airplane wheel and brake assemblies, incorporating multiple-disc hydraulically operated wheel brakes. Altogether, National Acme produces about 27 different sizes of wheels and a somewhat smaller range of brake sizes. Most of the wheels are of cast Dowmetal, magnesium alloy, a few sizes being made of aluminum alloy.

By JOSEPH GESCHELIN

The wheel and brake assemblies are fabricated and assembled here, shipped to Goodyear for mounting the tires. The manufacturing facilities in this department are being rapidly expanded to achieve a goal of about 4500 units per month. Currently the company has an order for some 83,000 units, entailing the use of over 1,500,000 pounds of Dowmetal. The hydraulic brake, illustrated here, was developed cooperatively by Wright Field, Goodyear, and National Acme engineers.

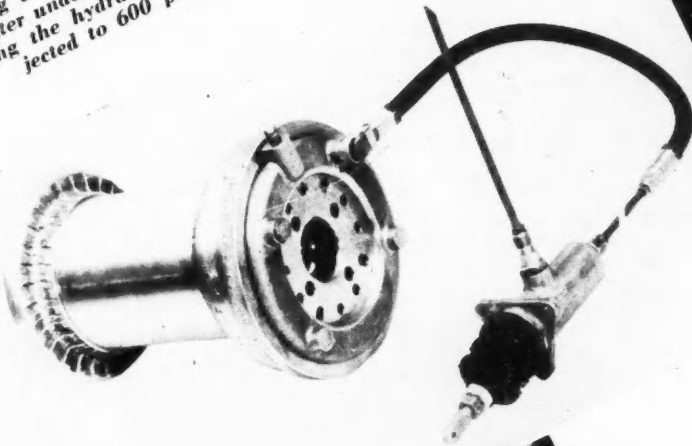
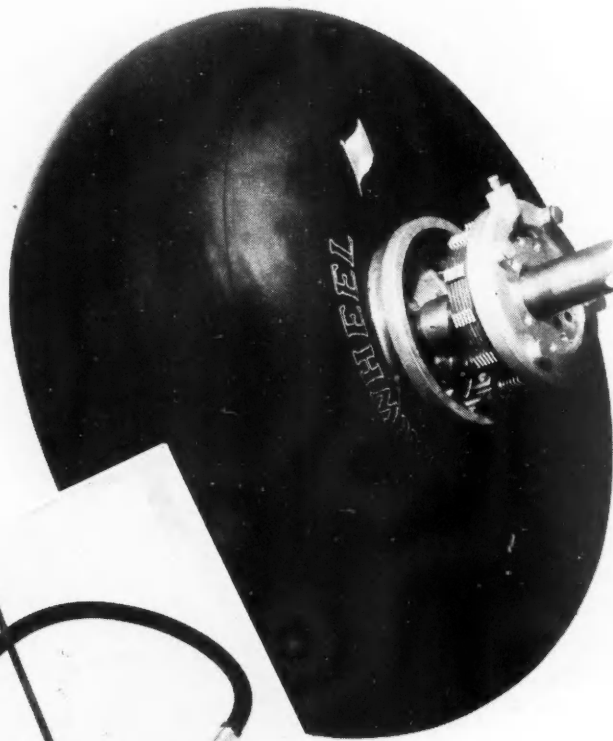
The Dowmetal magnesium alloy is said to be an ideal material for airplane wheel castings due to its extreme lightness, about 30 per cent lighter than aluminum, high physical properties, and excellent machineability. An important contribution in this connection is the development of some simple methods which assure the rapid machining of Dowmetal with the minimum of fire hazard.

Although The National Acme Co. is best known as the manufacturer of the Acme-Gridley multiple-spindle bar and chucking automatics, the Contract Mfg. Division which is handling the Goodyear project is by no means a new activity. Most of our

(Top)  
Six-inch wheel assembly mounted with tire. Brake assembly partly withdrawn to show detail of disc type design

(Center)  
Six-inch brake assembly with hydraulic lines and master cylinder

(Bottom)  
Testing brake anchor bracket piston cavity in water under air pressure of 100 psi. Following the hydraulic test, the part is subjected to 600 psi structural test



readers will recall that the company has served as a parts supplier to the automotive industry for a great many years, providing in the process a proving ground for the performance and improvement of its bar and chucking machines.

It is of interest to note that the contract division has set apart a large manufacturing department occupying 70,000 sq. ft. of floor space for the Goodyear contract. This department has been fully equipped with the necessary items of production machinery, including Warner & Swasey turret lathes of various sizes, a number of Bullard V-T-L machines, several King vertical turret lathes, broaching machines, milling machines, grinders, thread millers, drill presses, vapor degreasers, paint spray booths, assembly and inspection benches. As mentioned earlier, these facilities are being increased progressively to step up the output.

From the standpoint of labor, it is well worth noting that the bulk of the personnel employed in the wheel department is composed of



## Routing of Operations

### OPERATION AND EQUIPMENT

1. Completely **MACHINE** one end  
Bullard V-T-L
2. Completely **MACHINE** other end  
Bullard V-T-L
3. **DRILL** and **REAM** 10 spline insert holes  
Foote Burt drill press
4. **BORE** one end for spline inserts and **KNURL** one flange  
Warner & Swasey turret lathe
5. **KNURL** other flange  
Warner & Swasey turret lathe
6. **DRILL** valve hole  
Carlton radial drill press
7. **DRILL** and **TAP** seal holes  
Allen drill press
8. **DRILL** outboard cover holes  
Allen drill press
9. **BURR** complete  
Bench
10. **WASH** complete  
Detroit-Rex Products vapor degreaser—tank
11. Dichromate **TREAT**  
Dipping
12. **WASH** complete  
Detroit-Rex Products vapor cleaner—tank
13. **DIP** wheel in hot water and **assemble** bearings  
Bliss arbor press
14. **DIP** wheel in hot water and **ASSEMBLE** 16 drive inserts  
Bliss arbor press
15. **DRILL** and **ASSEMBLE**  $\frac{1}{8}$  in. pins holding 16-drive inserts  
Bliss arbor press
16. **WASH** complete  
Detroit-Rex Products vapor degreaser—tank
17. **PAINT** complete—3 coats  
Spray
18. **BALANCE** wheel—static  
Axle secured to bench
19. **GREASE** bearings  
Bench
20. **ASSEMBLE** complete  
Bench
21. Final **INSPECTION**

young men of high school age who have been trained for the specific job on hand. Another outstanding feature of the operation is the fact that this department works three shifts, utilizes the full 24-hour daily schedule.

As an example of the nature of the machining operations on a typical wheel, we have reproduced a routing of operations together with a listing of the equipment employed at each step.

Referring to this routing, it may be noted that the tooling of the first and second operations on vertical turret lathes employs an extremely wide forming tool which takes the entire contour of the flange section at each end. Going further along on the routing to operations 13 and 14, it will be observed that certain sub-assembly operations employ shrink fits to assure permanency. For these operations, the wheel casting is heated in hot water to 180 deg. F. In the case of the bearing assembly, each of the cups is chilled in dry ice, in addition, to provide the clearance for an interference fit.

Another interesting point is the use of vapor degreasing for chemical cleaning prior to dichromate treatment, after the dichromate dip, and prior to zinc chromate and aluminum paint spraying.

Consistent with airplane practice, each individual part of the wheel and brake assembly is inspected 100 per cent to assure conformity to specifications. In addition, each part as well as the brake assembly and complete assembly of the brake and wheel, is checked by Goodyear inspectors, certified by Army inspectors.

In view of the increasing use of magnesium alloys in airplane parts production, it is well to note the procedure which has been adopted to assure rapid metal removal with the minimum of fire hazard. We are told that the basic step to this end is the use of proper rake and clearance on cutting tools and the maintenance of a sharp cutting edge at all times. Tool replacement and tool grinding are done at reg-

ular and frequent intervals, depending upon the nature of a given operation.

In addition to the maintenance of sharp cutting edges, each operator is charged with the responsibility of keeping the machine bed free of chips. Chip removal, therefore, is a frequent function on every machine in this department.

Chief function of the cutting fluids used on the metal cutting operations is that of a coolant. They

(Turn to page 69, please)



One of a battery of new King vertical turret lathes set up for turning and facing operations on Goodyear airplane wheels. Note the big forming cutter on the horizontal cross slide for forming the flange contour.

**W**RIGHT FIELD, the "proving ground" of the U. S. Army Air Corps, is a busy center of air activity these days. There rigid tests are being applied to Uncle Sam's latest military planes, including a wide variety from 30-ton bombers, high speed pursuits, observation, cargo, and photographic airplanes, various training planes, to a tiny half-ton short range liaison craft. Their power ranges from 6000 hp. or more down to a mere 65 hp. Next on the schedule is

*In the flight test laboratory is every conceivable form of measuring device for recording speeds, rates of climb, pressures, temperatures, flight paths and other elements contributing to a scientific picture of the airplane's performance characteristics. The technician is holding a photographic observer, which takes simultaneous readings of 34 separate instruments, a development for flight testing of huge airplanes in the XB-19 class.*

the world's largest bomber, the Douglas XB-19. Passing these tests is necessary for approval to start production.

A standard performance test is used to determine whether an experimental airplane meets minimum requirements, or whether a production airplane comes up to the performance guaranteed by the manufacturer. The fundamentals of this test include calibration of the air speed meter; determination of high speeds at various altitudes and of cruising, or operating speeds; saw-tooth climbs; check climbs; take-off and landing characteristics; engine cooling tests; various tests of military equipment, and pilot's observations. These techniques frequently demand maintaining constant speeds within plus or minus 1 m.p.h., or absolutely level flight instead of approximately level.

To calibrate an air speed meter, the test pilot makes at least five two-way runs over a measured course at

## Testing Army



*Running a test with the YP-38, Lockheed-built interceptor powered by two Allison engines.*



*Montage of the many different military aircraft under test at Wright Field*

Official Photos, U. S. Army Corps



INDUSTRIES  
AVIATION

## Warplanes at Wright Field

an altitude of about 25 ft. The runs are made at approximately equal intervals between the high speed and the minimum safe flying speed of the airplane. It is vitally important to keep the air speed and altimeter readings constant during each run. If the pilot finds that the speed has changed after entering the course, he immediately turns out and starts over. Each of the runs is timed with a stop-watch. The times, together with the indicated air speeds and free air temperatures, are later converted to calibration speeds by applying temperature-pressure corrections for the whole speed range of the airplane.

In the speed runs, the limits of precision in determining horizontal speed at sea level or at altitude must be within plus or minus 1 per cent. The cruising speed is determined by using the normal rated power of the engine, not to exceed a maximum of 75 per cent.

Saw-tooth climbs, so named because the tracings on the barograph record of a properly executed saw-tooth climb look like saw teeth, are employed to determine the indicated speed at which the maximum rate of climb occurs at different altitudes. The maximum rate is obtained by climbing the airplane through specified altitude ranges at various speeds with full power.

Check climbs establish the true rate of climb from sea level to the airplane's service ceiling, the point at which the rate of climb drops off to 100 ft. per min. In this test, the airplane is climbed steadily to its service ceiling at the indicated speeds established for each zone by the saw-tooth climb. Readings recorded for a check climb are free air temperature, r.p.m.,

manifold pressure, and carburetor air temperature. Time and pressures are recorded by a barograph, and all data are coordinated with pressure altitude.

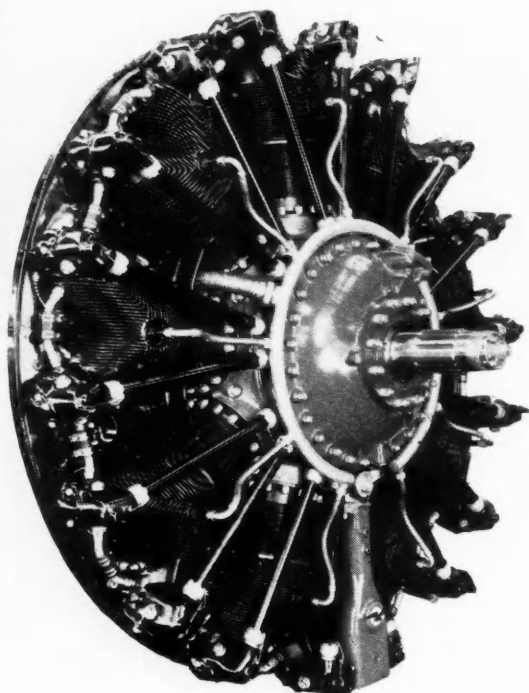
Involving more real hazard than some of the more spectacular tests, take-off and landing tests are executed under maximum operating conditions on or near the ground. The object is to establish the minimum distances within which the airplane can take-off and clear a 50-ft. obstacle, and come to a stop after landing over a 50-ft. obstacle. In the take-off tests, flaps are set at various positions, from fully closed to fully open, to determine the best flap position for a minimum run and getting the airplane off the ground and over a 50-ft. obstacle as quickly as possible. The landing tests are just the reverse—landing the airplane and braking it to a stop as soon as possible after passing over a 50-ft. obstacle. The landing and take-off characteristics are obtained to determine the minimum size of the base from which the airplane can be operated.

During the engine cooling tests, the test pilot first flies for 30 min. in level flight at 2000 ft., with military load and full power. Then he pulls into a climb and continues at best climbing speed to within 2000 ft. of the service ceiling. Afterward a ground cooling test is obtained at 60 per cent of the ground r.p.m. permissible.

The test pilot also must answer 157 questions about the airplane's controllability, stability, trim, balance, maneuverability, interior arrangement of equipment and controls, and all-round characteristics in the air

*(Turn to page 70, please)*





# Air-Cooled vs. Aircraft

**S**INCE the beginning of commercial aviation in this country, the air-cooled type of engine, for various reasons, has had the preference, and in recent years it has been used almost exclusively. In some branches of military aviation, however, and especially abroad, the liquid-cooled engine has more than held its own.

Now that the American aircraft industry has swung from commercial to military planes, this problem of air-cooled vs. liquid-cooled engines is of timely interest. Recently, before two engineering societies, the case of the air-cooled engine and that of the liquid-cooled engine were presented separately by outstanding advocates of the two types. The arguments for each type have been abstracted from these two papers and are given together here.

In a paper "Air-Cooled vs. Liquid-Cooled Aircraft," presented at a recent meeting of the Institute of Aeronautical Sciences, John G. Lee of United Aircraft Corporation, gave data showing how the drag, weight, cooling and fuel consumption of aircraft are affected by the engine cooling system used. The air-cooled engine undoubtedly requires a nacelle of somewhat greater forwardly projected area, and this has led to the impression that it will cause greater drag, but Mr. Lee asserted that the drag of the nacelle is dependent not so much on its cross sectional as on its surface area.

It has been shown by Meredith and others, he said, that if air is admitted at high speed to a passage, expanded through a diffuser to a condition of low velocity and high pressure, and then heated, the heat energy imparted to it may be recovered as a thrust,

if the air is discharged rearwardly through a nozzle. This principle was taken advantage of first on planes with liquid-cooled engines, by providing the radiator with a duct. Recently this same principle has been applied also to air-cooled engines. The effectiveness of this method of energy-recovery improves with increase in speed, and Mr. Lee expressed the opinion that the cooling drag ultimately would be reduced to zero.

As regards specific fuel consumption, he said, it was admitted that under full throttle the consumption of the air-cooled engine was materially greater, but aircraft, and even the pursuit type, operate under full throttle only a small fraction of the time. Many conflicting data on specific fuel consumption have been published, and it is almost impossible to compare a group of liquid-cooled with a group of air-cooled engines and obtain generally valid results. Mr. Lee, therefore, gave fuel consumption figures for two single-cylinder test engines of the same size (it was, in fact, the same engine, the cooling fins on the original cylinder having been turned off and replaced by a cooling jacket). The graph showed that up to a b.m.e.p. of 173 lb. per sq. in., which was its detonation limit, the engine, when air-cooled, had a specific consumption of 0.34 lb. per hp.-hr., while its specific consumption when liquid-cooled was substantially 0.36 lb. per hp.-hr., up to its detonation limit of 223 lb. per sq. in. b.m.e.p.

The liquid-cooled engine by itself, said Mr. Lee, is somewhat lighter than the air-cooled one, but when the complete installation is considered, the air-cooled powerplant has the advantage. A tabulation of weights and actual engines and actual installations showed that on the basis of take-off horsepower, the average weight of the air-cooled engine is 1.31 lb. per hp., and its installation weight is 0.63 lb. per hp., which makes the average installed weight 1.94 lb. per hp. He gave the corresponding figures for the liquid-cooled engines as 1.18 lb. per hp. for the dry engine and 0.91 lb. for the installation, which makes the average installed weight 2.09 lb. per hp. Thus the water-cooled installation, he concluded, is about 7.5 per cent heavier than the air-cooled.

According to Mr. Lee, it follows from the foregoing that the air-cooled airplane can accommodate a more

# Liquid-Cooled Engines

powerful engine, together with the extra fuel which it requires. This extra power, he said, enables the air-cooled pursuit plane, in spite of its slightly greater form drag, to equal or surpass the liquid-cooled pursuit plane in speed. Conditions, he said, were similar for high-speed bombers, while for long-range bombers and transports the air-cooled type had a definite advantage.

In conclusion he pointed out that air-cooled engines of 2000 hp. are in production in America today, while the liquid-cooled type is, as yet, available only up to approximately 1100 hp. The fact, he said, that liquid-cooled engines power the fighting planes of England and Germany is not an argument that these engines should be used by the United States, as these foreign types were "frozen" about three years ago, and the decision had to be made on the basis of knowledge available at that time. As a result of continued research, more up-to-date knowledge is now available, and that, he asserted, points to the superiority of the air-cooled engine.

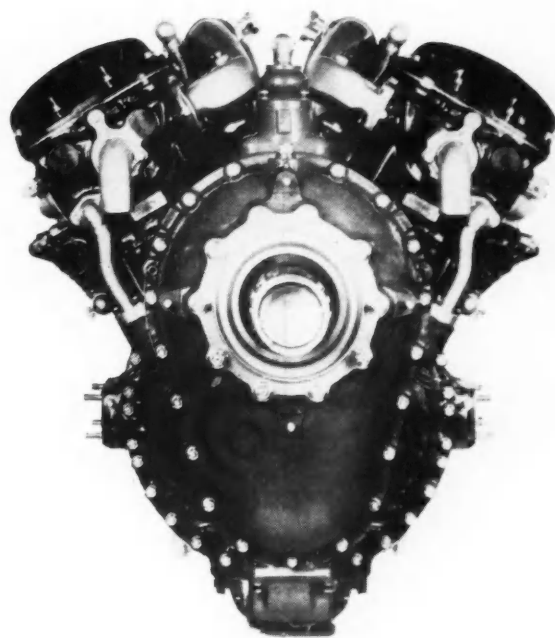
In a Detroit Section S.A.E. paper on "The Allison Aircraft Engine Development," R. M. Hazen dealt mainly with the development work done on the Allison engine during a period of nearly a decade before it finally went into quantity production. There were three underlying reasons, he said, for the original choice of the liquid-cooled V-type of construction. He stated them as follows:

1. The V-12 type of construction with its small frontal area could be installed with less drag than any other type of engine.

2. A liquid-cooled engine could be operated at a higher power output per cu. in., due to the type and uniformity of cooling.

3. The liquid-cooled engine would be more reliable, because it is less sensitive to temporary overloads, on account of the heat capacity and limiting temperatures (boiling) of the coolant.

Airplanes designed for V-type engines, because of the close correlation between the engine profile and that of the pilot, can be made with smaller fuselage dimensions and yet allow wide latitudes for armament and other installations without appreciably affecting airplane size. "It has always been our feeling," said



Mr. Hazen, "that there would be an application for the smallest airplane with high performance which would enclose a pilot. This is, and probably for some time will continue to be, the airplane most economical to produce, easiest to tool and capable of the greatest production which can be made available. It also appears that the power and altitude characteristics of these engines can be increased rapidly enough to keep this type of airplane well out in the forefront as a military type."

As to the relative advantages of air-cooling and liquid-cooling for high-output aircraft engines, Mr. Hazen submitted the following:

"Until the liquid-cooled engine entered the pursuit field, the average yearly increase in speed of pursuit aircraft was 10 to 15 m.p.h. The first year a liquid-cooled engine was in competition, the increase in speed was approximately three times the maximum previous annual increase. It has been reported on good authority that on similar installations with engines of approximately the same horsepower, the liquid-cooled engine cruised about 60 m.p.h. faster (and, therefore, farther in one hour) on the same number of gallons of fuel per hour. This point is of interest not only in pursuit airplanes but in commercial service and bomber types as well. It should also be kept in mind particularly with reference to the recent comparisons between 2000 b.hp. air-cooled engines versus 1150 b.hp. liquid-cooled engines. On this point it is worth noting that while 1500 and 1800 b.hp. air-cooled engines have been available for some time, the one-sided controversy on top speed was not brought into the

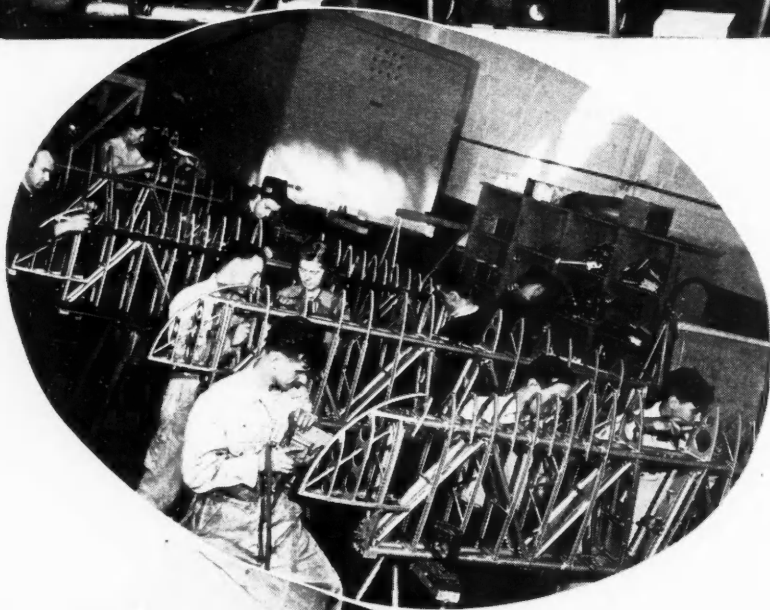
(Turn to page 60, please)



# Hurricanes

(Left) A youthful pair working side by side in assembling a rudder

(Oval) At work on the final assembly of Hurricane stabilizers



(Lower left) Many feet of different tubing are required for oil lines, for the hydraulically-operated retractable landing gear and other equipment. Each bend is inspected carefully. The young worker at the right has placed a steel ball in the tubing and is listening as it rolls through. If the bearing sticks, the piece of tubing is rejected

(Center below) Some idea of the hand work that goes into the manufacture of this modern fighter may be gained from this partial view of sheet metal workers' benches at Fort William



Photos from Three Lions



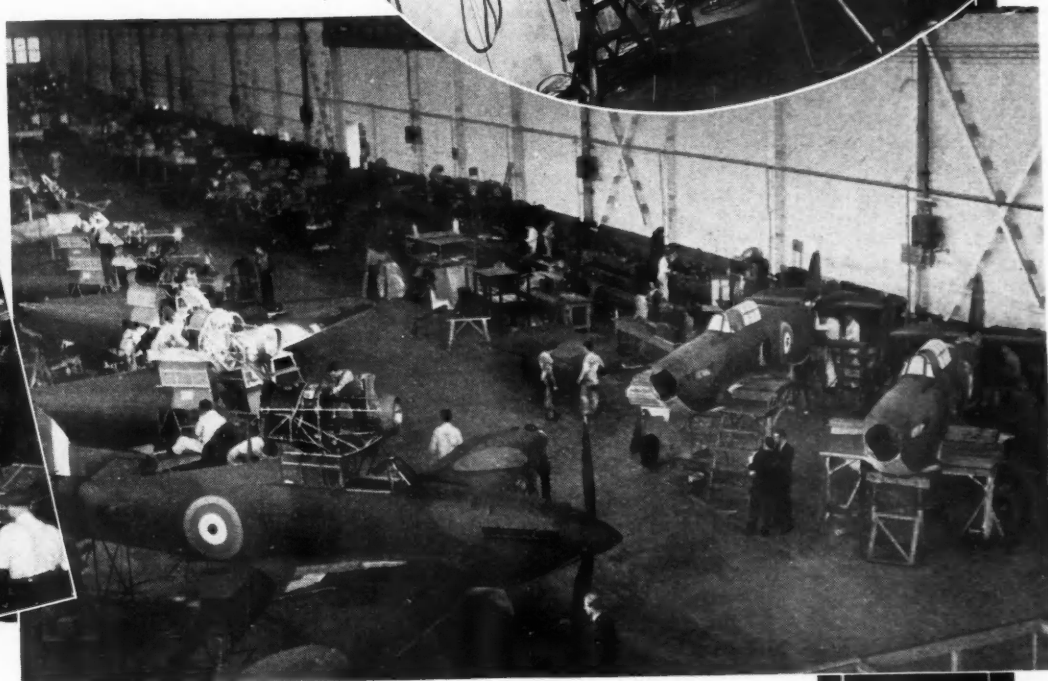
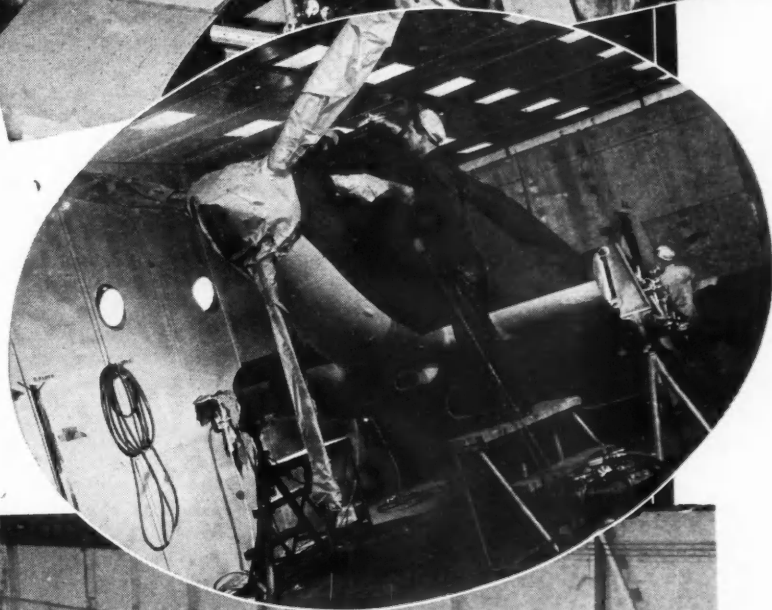


# from Canada

(Right) Part of the primary assembly line at the Hurricane plant. A worker is installing the electrical wiring for the instruments

(Oval) Finishing touches before shipment include its camouflage. Official specifications call for a coat of "duck egg, greenish blue" paint on the undersurface

(Lower right) This view shows part of the assembly line in the Hurricane plant at Fort William, Ontario, where 15 of these famous British fighter planes are turned out each week for shipment to Great Britain. They are powered by the Rolls-Royce Merlin III, rated at 1030 hp. at 3000 r.p.m. at 12,250 ft. Maximum speed is 335 m.p.h. at 17,500 ft.



# Airbriefs

By HENRY LOWE BROWNBACK

## Fire Prevention

One of the principal bugaboos of aviation, and particularly military aviation, has been fire either in the air due to fuel leaks caused by gunfire or crash landing fires. The crash landing fire problem was more serious in the World War I than it is today because the parachute has been perfected since then. It is still a very definite hazard in planes working from aircraft carriers. After the last war extensive experiments were carried on to determine just how fires originated and how to prevent them.

It is interesting to remember that self-sealing tanks had been used in several foreign planes during World War I, the most usual form being metal tanks covered with several layers of thin rubber stretched at different tensions and the whole covered by a wire netting. When the protected tank was pierced, the rubber crept over the hole and thus sealed it.

As further insurance against fires, some of the machines carried their tanks on trap doors in the bottom of the fuselage. The trap door could be released by the pilot and the tank forced out by rubber shock cords stretched over it. This not only rid the plane of its leaky tank, but lightened it for the glide.

Post war demands for speed and climb made weight a factor of primary importance and metal tanks continued to be used in most fighting craft. When it became evident that pilot morale demanded some sort of self-sealing tanks, all sorts of experiments were tried, usually based upon a metal tank. One form kept the tank under vacuum another had the inside coated with soft synthetic rubber, another used a double walled tank with soft rubber between the walls.

The metal tank has one disadvantage—when it is pierced, the hole left is not a clean hole, but has prongs which sometimes bend over the sealing element and prevent it from doing its work. Consequently, attention has turned to non-metallic tanks. The Germans have been using tanks having a casing of five layers of non-metallic material. The outside is made of heavy black vulcanized rubber, then several layers of thin rubber, followed by a layer of soft soluble rubber compressed to a thickness of six mm. fixed to a layer of hide. The inside is of hard

vulcanized material almost as hard as metal. Here might be a place for the use of plastics.

## Plastic Bearings

We hear much of plastics these days—clear glass-like plastics moulded into windshields and even complete nose sections of fighting airplanes, plastic aileron, rudder and elevator tabs, plastic goggles, Nylon parachutes, and now we have plastic bearings—made of Nylon.

It is stated that these Nylon bearings will carry heavy loads in all sorts of machines such as electric motors, and require no lubrication whatever. Another bearing material has been made from ethylene gas a by-product of some of the cracking processes. This gas is converted by heat and pressure into a solid polymer, which can be moulded into bearings.

## Fluid Driven Supercharger

While the fluid driven supercharger of the Mercedes-Benz engine created a surprise and rather a furor here, it is known that the Germans are conducting extensive experiments with turbo-superchargers with a view of using them in the new high altitude fighters and bombers which will soon replace the present machines.

## Plate Forming

Some interesting set-ups have been made for the forming of the plates used in the production of metal airplanes, not the least notable being the Guerin process used at Douglas. Here one die only is used, a thick rubber pad being substituted for the other half. It is said that this results in speeded production and lowered costs.

## Greater Fire Power

The RAF started out as a defensive unit rather than an offensive air force. This explains the lack of bombers as compared to the Luftwaffe and the

superiority of the Spitfire and Hurricanes over even the formidable Messerschmitt. We have only to look at the tremendous fire power of these modern fighters to see how aviation has changed in the past five years.

At the beginning of the Spanish Revolution, the average plane of the fighter type carried two guns and sometimes two machine guns and a cannon. The first Spitfires carried four machine guns and two cannon, giving them tremendous fire-superiority and the late models carry eight machine guns and four cannon converging about 250 yards in front of the machine.

Naturally the range of such machines is limited as the guns require a tremendous amount of ammunition, even when fired by an expert. Their fuel consumption is high, but they are formidable weapons and their tremendous speed permits them to cover a great deal of territory in the comparatively short time that they can keep in the air.

## Navy Torpedo Bomber

The Navy will soon have a new torpedo bomber to be known as the TBF-I, built for it by Grumman. Naturally the details are secret, but it is said that it will be so far in advance of the present-day torpedo bombers being used in Europe that it makes them look like the World War "Jenny" compared to a modern streamlined fighter.

This is a new departure for Grumman, which has heretofore more or less specialized on shipboard fighters, although it has built many single seater fighters for the British, who call the machine the "Martlet."

## Service Details

The field servicing of planes being used far from the factories is being taken seriously by the Luftwaffe and has received much study. The engines and other mechanical parts are mounted so that they can be changed very quickly. All of the hose and wire connections are of the quick-locking type not unlike the hose couplers used between railway cars.

During the last war I was struck forcibly by the care with which the Germans installed their engines. They had little tubular drains with wire screened pans or drip funnels under every point where oil or gas might drip in the engine compartment. Such little details mean much in fighting aircraft as stray oil or gas may be set on fire easily by an incendiary or tracer bullet.

# Explosive Rivets

## Solve "Blind" Fastening Problem

**S**O-CALLED explosive rivets, manufactured by E. I. du Pont de Nemours & Co., Wilmington, Del., are now being used in aircraft production, especially in locations where it is impossible to get at both ends of the rivet. A high explosive is incorporated in a cavity at one end of the shank. To set the rivet, heat applied to its head by means of an electric gun detonates the charge and the explosion expands the charged end, thus forming a "blind" head. It is estimated that in an all-metal pursuit plane some 800, and in the largest all-metal bomber as many as 10,000 fastening points are accessible from one side only.

Du Pont explosive rivets may be set at the rate of 15 to 20 per min. by one man, once they are in place. The riveting gun or iron weighs less than 5 lb. and it is claimed that the rivets themselves weigh only about one-fourth as much as blind fasteners of the type generally used. The explosive charge in the rivets is sufficiently controlled so that the expansion of the rivet shank may be held within 0.020 in.

In 1921 an American, Frank Allan, patented several types of explosive rivets and bolts, and hoped they might prove the solution of the "blind" rivet problem. However, his rivets were not considered commercially

feasible. Then, in 1937, a patent issued by the U. S. Patent Office to Karl and Otto Butter, two brothers employed by Ernst Heinkel, the German airplane manufacturer, revived the idea of setting "blind" rivets by expanding the shank with a minute explosive charge.

Early in 1939 the du Pont Explosives Department became interested in the idea and began to seriously explore its possibilities. The Butter rivet from the outset seemed to offer advantages over all other existing types of "blind" rivets and to offer attractive possibilities. Accordingly, the North American rights to the invention were purchased from the American Explosives Rivet Company, which had previously acquired them from Heinkel, to whom they had been assigned by the inventors. An extensive research and development program was launched by the du Pont's Eastern Laboratory at Repauno, N. J.

While fundamental details were disclosed by the patent, many problems remained to be solved. The design had to be adjusted to American standards of precision; a new method of manufacturing the rivets was necessary, since the very small tolerances could not be held with existing equipment; the anodizing process had to be

(Turn to page 70, please)



Fig. 2—Operation of setting explosive rivet

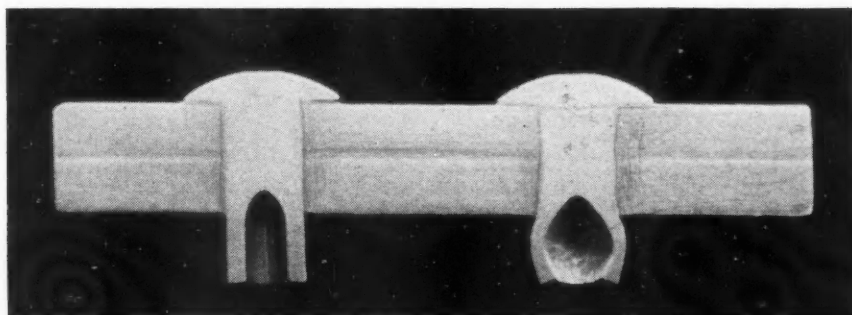


Fig. 1—Du Pont explosive rivet inserted and set



# More About

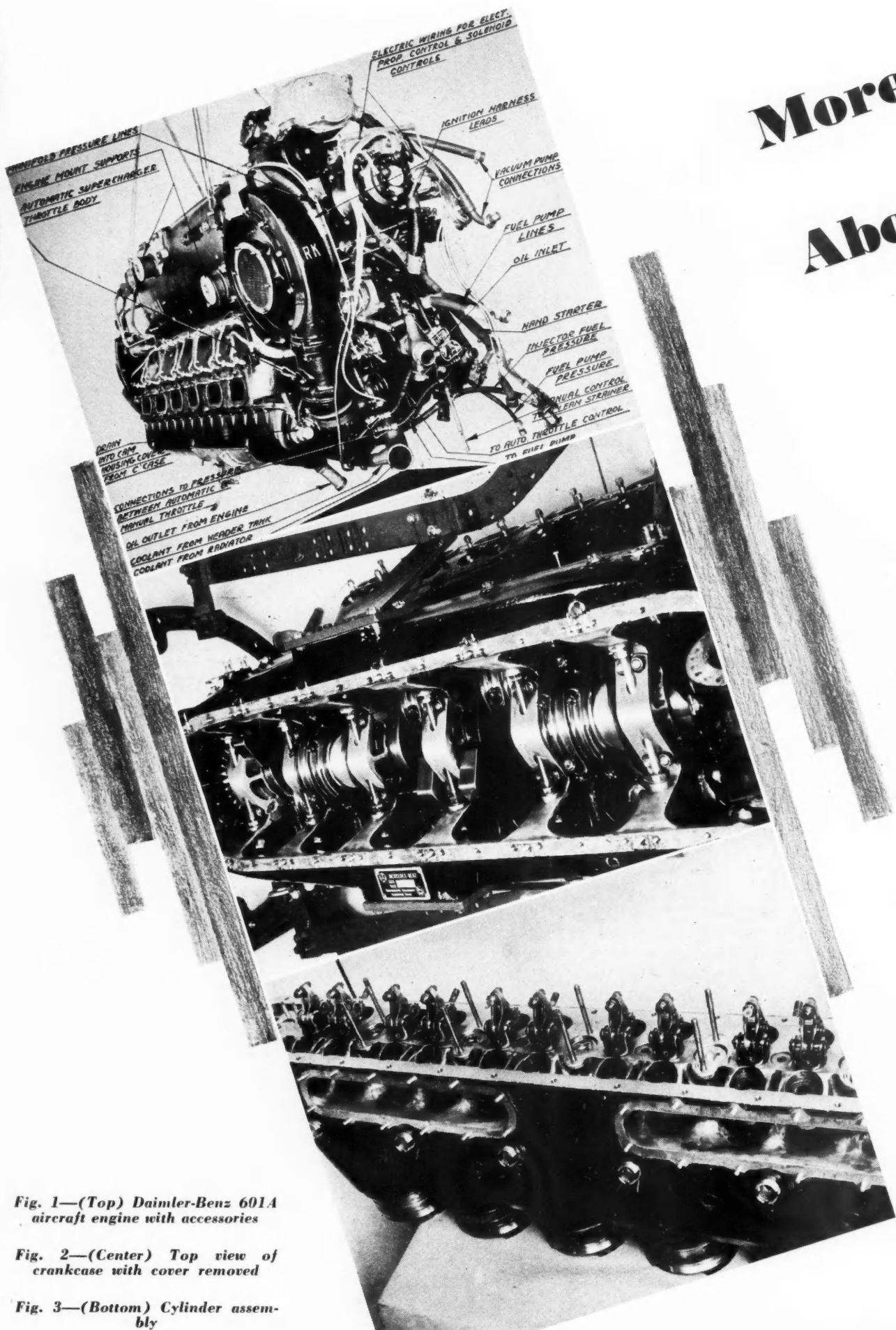


Fig. 1—(Top) Daimler-Benz 601A aircraft engine with accessories

Fig. 2—(Center) Top view of crankcase with cover removed

Fig. 3—(Bottom) Cylinder assembly

# the 601-A Daimler-Benz Engine

**H**EREWITH are shown a number of additional illustrations of the Daimler-Benz 601A aircraft engine which was exhibited at the S.A.E. summer meeting and which was fully described in a paper by Raymond Young of the Wright Aeronautical Corporation.

Fig. 1 is a general-assembly view of the engine, with the supercharger and other accessories in the foreground. The engine illustrated was manufactured by the Niedersächsische Motorenwerke of Brunswick, which is believed to be a licensee of the Daimler-Benz Company.

Fig. 2 is a top view of the crankcase (of the inverted 12-cylinder engine) with the cover removed. It is an aluminum-alloy casting of deep section and well ribbed. The main bearings are carried in heavily-webbed sections with wide flanges. There is a tie bolt extending across the crankcase at each main bearing. These tie bolts, which are highly polished and secured into the crankcase walls by inside and outside nuts, pass through the bearing caps and add greatly to the rigidity of the whole structure. Each main-bearing cap is secured by four stepped and mirror-finished studs. Nuts on these studs are finely serrated and bear on washers with spherical seats.

A problem in connection with inverted engines that always arouses some curiosity is how the oil that gets into the pistons is taken care of. It appears that if oil in any quantity gets into the inverted pistons, it is thrown out immediately by the acceleration imparted to it by the piston. Oil thus thrown out, together with that collecting on the crankcase walls, collects in oil drain passages at the bottom of the crankcase around the cylinder liners extending into the case. The joint between the crankcase and cover is worth studying. It will be

seen from the photograph that there are a large number of two sizes of studs in the crankcase flange, approximately  $\frac{5}{16}$  and  $\frac{1}{8}$  in. Between the studs of each group, comprising one large and two small ones, are laid two horizontal dowel pins, approximately  $\frac{3}{16}$  by  $\frac{3}{4}$  in. Mr. Young said he did not quite see the necessity for this complicated joint construction, but aside from this, the crankcase was a good production set-up.

Each bank of six cylinders is in a single casting. The cylinder head and its jacket form an unusually smooth-walled casting and the port flanges and cam deck present a good milling set-up. There is one inlet port for three cylinders, and this is smoothly hand-polished and the bosses and port walls are streamlined. Fuel injection nozzles fit into adapters that screw into the head at a slight angle, to properly direct the spray. Bronze valve guides are used, with a measured clearance of 0.0025 in. on the inlet and 0.0036 in. on the exhaust valves. Dry cylinder-liner construction is employed, steel liners being screwed into the head. The open end of each liner is threaded externally where it projects into the crankcase above the deck flange, and a locking ring nut and washer clamp the block with its gasket against the crankcase deck. Tightening of the ring nut is effected through the gear teeth on its periphery which are engaged by a pinion wrench pilot-

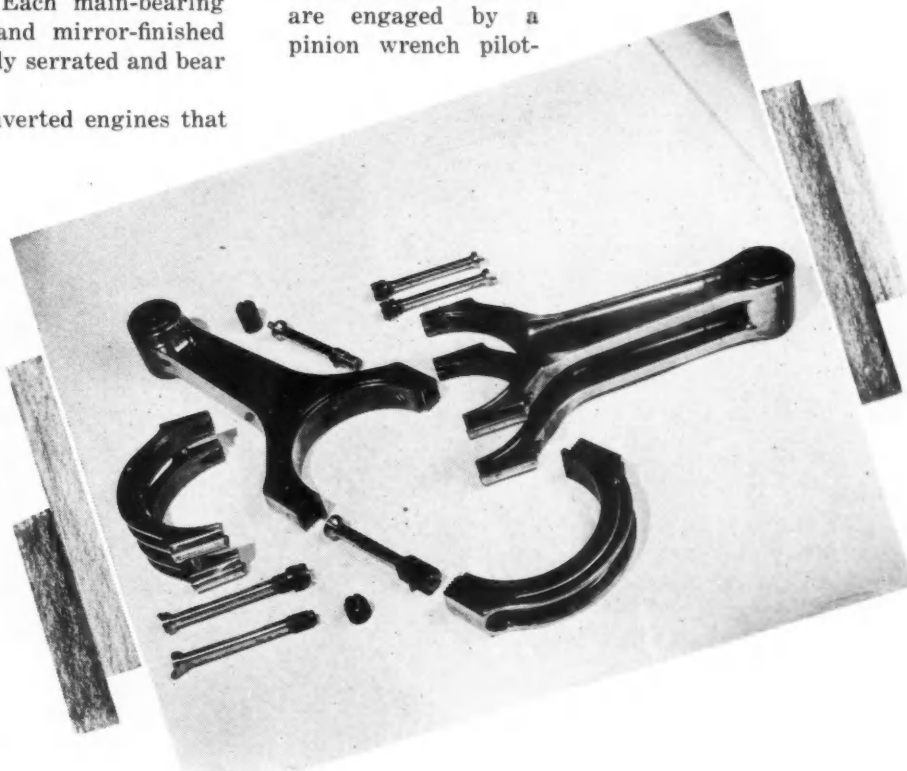
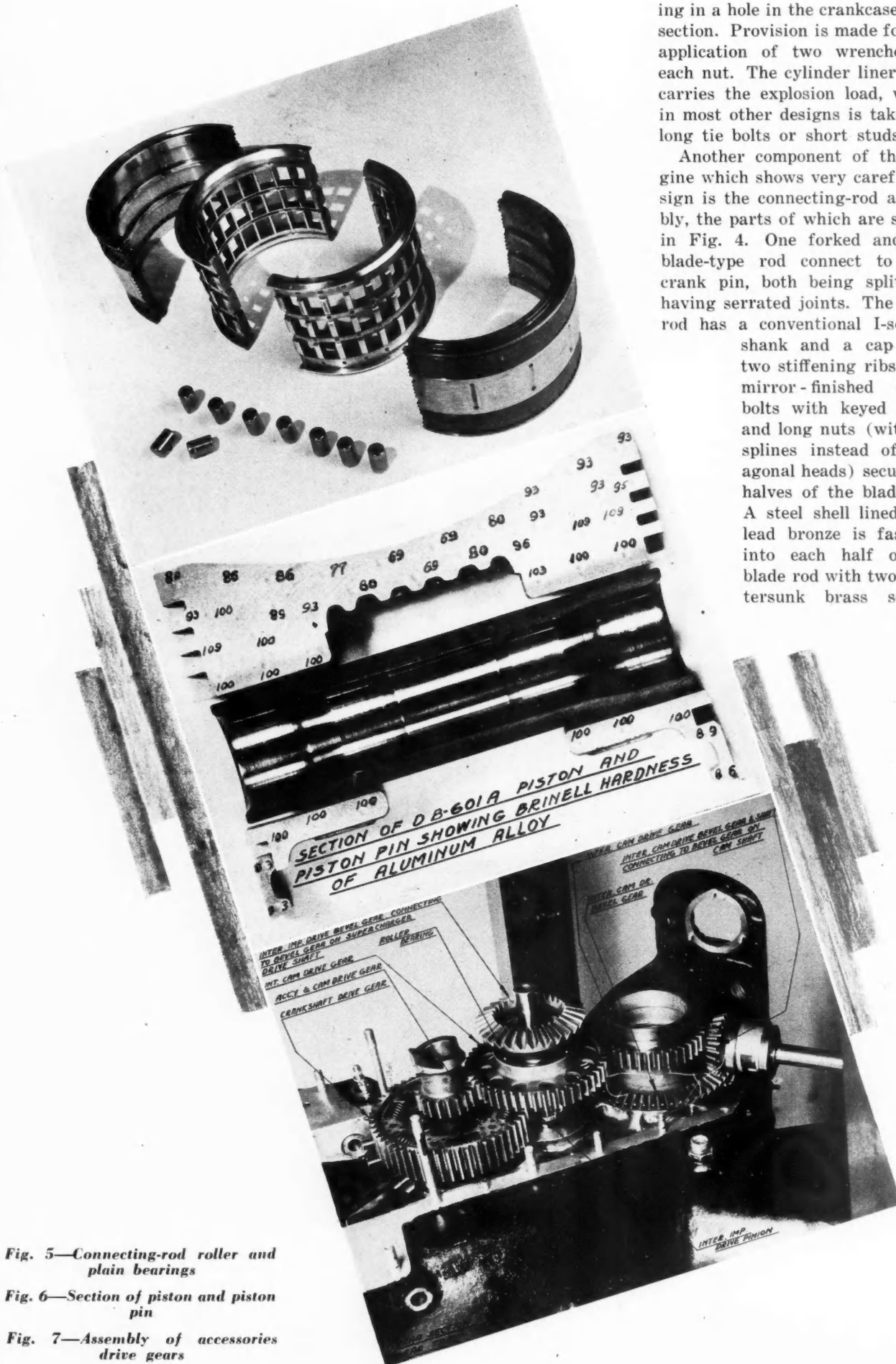


Fig. 4—Parts of the fork and blade connecting rods

Fig. 5—Connecting-rod roller and plain bearings

Fig. 6—Section of piston and piston pin

Fig. 7—Assembly of accessories drive gears



ing in a hole in the crankcase deck section. Provision is made for the application of two wrenches to each nut. The cylinder liner thus carries the explosion load, which in most other designs is taken on long tie bolts or short studs.

Another component of the engine which shows very careful design is the connecting-rod assembly, the parts of which are shown in Fig. 4. One forked and one blade-type rod connect to each crank pin, both being split and having serrated joints. The blade rod has a conventional I-section shank and a cap with two stiffening ribs. Two mirror-finished clamp bolts with keyed heads and long nuts (with vee splines instead of hexagonal heads) secure the halves of the blade rod. A steel shell lined with lead bronze is fastened into each half of the blade rod with two countersunk brass screws.



The blade rod bears on the outer surface of a steel shell split with vee-serrated joint and fitted into the forked portion of the mating rod.

The forked-rod design incorporates a roller bearing (Fig. 5) in contact with the hardened crankpin. A forged duralumin cage, machined all over, for the three rows of rollers, fits within the steel shell and is located by means of circumferential flanges. This cage also is split and has a vee-serrated joint. The serrated parting line of the roller-bearing housing and cage is offset angularly approximately 15 deg. from the similar parting line of the forked rod. The rollers, Mr. Young pointed out, seem to run over the serrated joint without trouble, undoubtedly because of the slight relief at this point. The forked rod has a shank of H section, with reinforcing ribs along each edge of the flanges and blending into the forks and piston-pin eye. The cap, with four stiffening ribs, is secured through a vee-serrated joint to the forks by four mirror-finished bolts with keyed heads. All connecting-rod bolts have copper-plated nuts and threads, undoubtedly to prevent scuffing and fatigue failure. The bolt heads bear on spherical seats in the rods. Contact surfaces between bearing shells and rods are shot-blasted to work-harden them and prevent fretting.

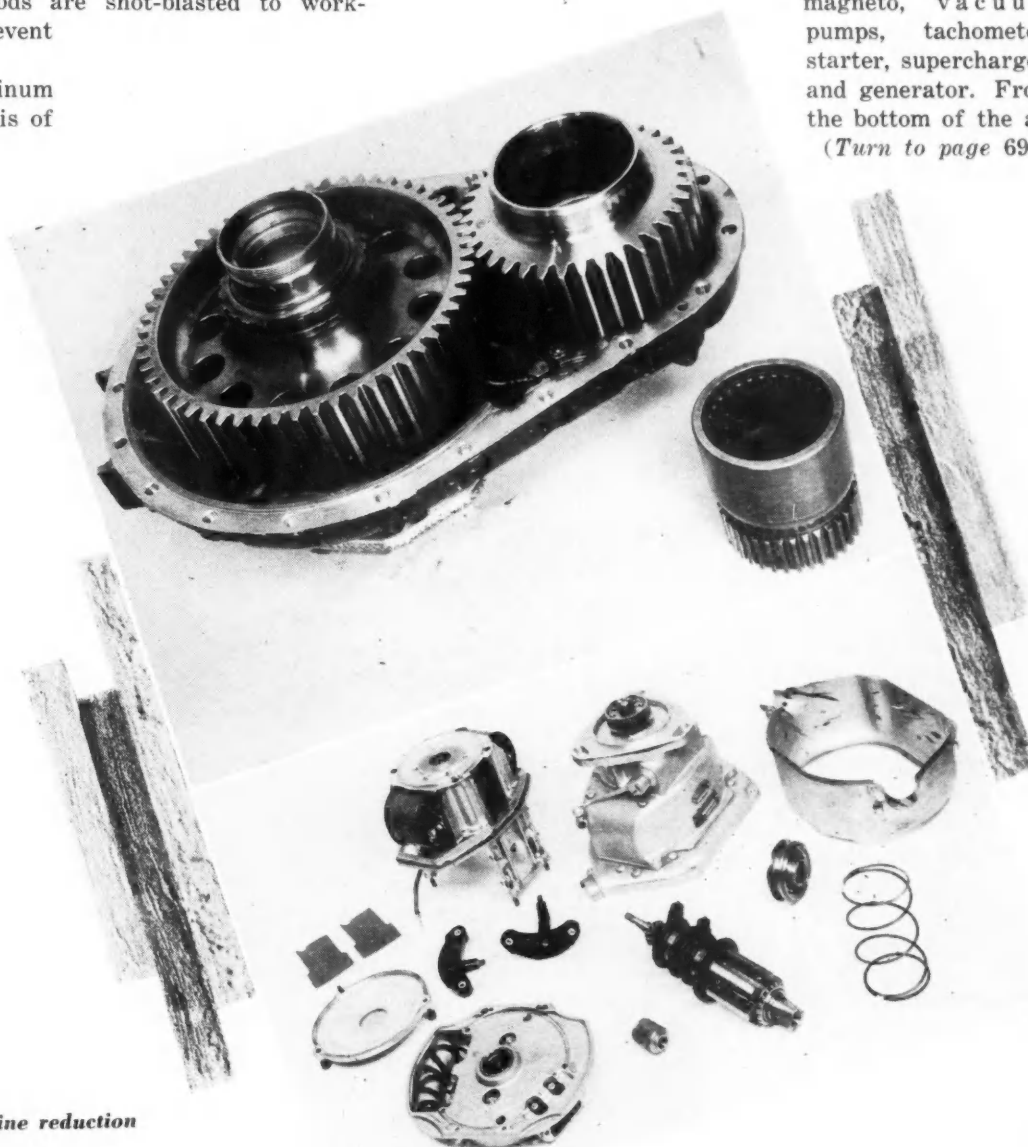
The forged aluminum alloy piston (Fig. 6) is of

conventional design. It carries three  $\frac{1}{8}$ -in. compression rings with staggered left- and right-hand 45-deg. gaps, and two  $\frac{3}{16}$ -in. slotted oil-control rings, one above and the other below the piston bosses. The figures on the section of the piston represent the Brinell hardnesses at the different points. The most interesting feature of the piston is the means adopted to insure an adequate supply of lubricant to the piston-pin bearing surfaces. Two  $\frac{3}{16}$ -in. holes are drilled in each boss to communicate with longitudinal grooves in the piston-pin bearing area and extending to within  $\frac{1}{8}$  in. of each end of this surface. The piston pin showed no discoloration from heat. In the photograph may be seen the straight and tapered wall sections of the pin. There is a machined duralumin plug in each end, with a radius on the head slightly less than that of the cylinder bore, these plugs being made quite long and fitting snugly in both bores of the piston pin.

Fig. 7 shows the assembly of accessories drive gears, which are housed in a one-piece aluminum-alloy cast housing secured to the flanged end of the crankcase by

means of studs. There are drives for the magneto, vacuum pumps, tachometer, starter, supercharger, and generator. From the bottom of the ac-

(Turn to page 69)



**Fig. 8—Spur-type engine reduction gear**

**Fig. 9—Parts of dual ignition magneto**

# Photoelasticity

**P** By CHARLES LIPSON, PH.D.\*  
HOTOELASTICITY which began 100 years ago as a purely academic study of optical phenomena, and as recently as the last decade has concerned itself almost exclusively with the verification of the stress theory, now begins to serve definite engineering needs. As this science continues to develop, particularly in the three-dimensional field, not only will the entire aspect of stress analysis be enormously broadened, but substantial improvements, involving weight and cost reduction, should result in the industrial field.

The principal function of the photoelastic laboratory is in the design stage. By providing quantitative data on the stress distribution it eliminates many costly and time consuming laboratory and design efforts commonly associated with a more conventional engineering method.

In general, automobile parts are subjected in service to the following three types of stress:

1. Steady State of Stress.
2. Cyclic Variation of Stress.
3. Transient State of Stress.

This corresponds to the static fatigue, and impact loading, each of which will be discussed separately.

In an automobile, parts are subjected to static loads when they are acted upon either by dead weights, preloads, or centrifugal forces. The first two are of slight importance in the study of stress distribution. The last one, however, demands careful consideration.

This is particularly true in parts of varying cross-sections, such as the flywheel for example, where a definite knowledge of the magnitude of stresses might often permit a useful modification of the design. Such problems represent a fertile field for photoelastic investigation, especially if the stroboscopic technique is adopted.

The great majority of

\*Chrysler Corporation, Engineering Division.

failures in automobile test parts is not due to a static loading or to impact stresses, but rather to a continuous repetition of small forces, well below the ultimate strength of the material. Some investigations emphasize the importance of these fatigue loads by claiming that 90 per cent of engineering test failures are due to fatigue.

Fatigue fractures are invariably characterized by a progressive crack, and cracks in turn are associated with regions of localized stress conditions. Since the photoelastic method enables one to locate quickly such regions, it can serve a useful purpose in facilitating redistribution of stresses.

## Gears and Bearings

In the case of gears, principal problems in which fatigue plays a major part are:

- a. The determination of the instant of maximum stress at various gear points. This probably can be established by means of a motion picture technique.
  - b. The increase in gear stresses due to manufacturing variations.
  - c. The effect of speed on the stress distribution.
- Coker and Filon state that the maximum stress at 1250 r.p.m. was found to be 90 per cent greater than when a static torque was applied.

Another problem of particular interest is the stress distribution in the rear axle hypoid gears, and again

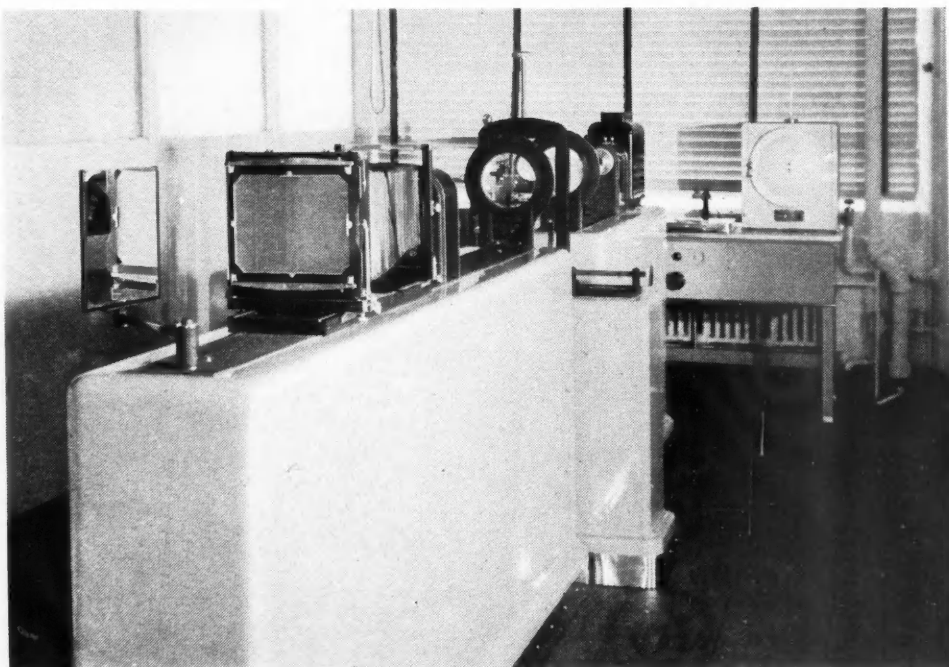


Fig. 1 — Polariscope used in Chrysler Corp. laboratories.

# in Automobile Engineering

Fig. 2. Loading frame for the Chrysler polariscope

this problem can be solved satisfactorily only through a three-dimensional photoelastic analysis.

The starter pinion and the flywheel ring gear require a special type of contact for a smooth engagement in all positions. For this reason the surface of contact becomes rather small and particular care must be exerted in order to prevent undue stresses.

Equal in importance to gear problems are bearing studies. In the case of the connecting rod bearing excessive stresses are created if the bearing boss is out of round. Such stresses would occur directly under the connecting rod strut due to the rigidity of the section adjacent to the bearing shell.

Life tests show a reduction of bearing temperature and thus an increase in bearing life when a hole is drilled in the web of the rod, directly above the bearing. Three-dimensional photoelasticity would be very effective in determining the location and the dimension of such a hole, although even with a two-dimensional analysis some useful information can be obtained.

Crankshaft main bearings are another subject of photoelastic investigation. Excessive stresses in these bearings may occur at the outer edges if the counterweighting is not made satisfactorily. Similarly, an analysis of bearing caps and of crankshafts aid in bearing development.

## Press-fit Assemblies

Press-fitted assemblies, such as gears and bearings on axles or shafts, are very common in automotive practice in connection with the rotating members. Such assemblies can be frequently regarded as an integral part containing a very small fillet at the junction

of the axle and the bearing (or the gear). Consequently, under certain experimental conditions high stresses can be created which may reduce the strength of the shaft by as much as 50 per cent.

Little can be found in literature on the effect of press-fitted members on the endurance strength of the shaft. Usual formulas for determining the press-fit pressure are based on the assumption that the two parts are of equal length and the resultant solution gives a uniform stress distribution. In practice the two members are unequal and the load increases rapidly near the end faces of the gear or the bearing. This unfavorable stress distribution is further complicated by additional bending stresses due to the axle rotation.

The situation can be greatly improved by design alterations involving relief grooves on the inside face of the wheel hub or the gear, or by the use of a raised pad on the shaft. The proper placement of these grooves is of primary importance because faulty application of such changes may reduce the fatigue limit instead of increasing it.

In this connection it is very useful to determine

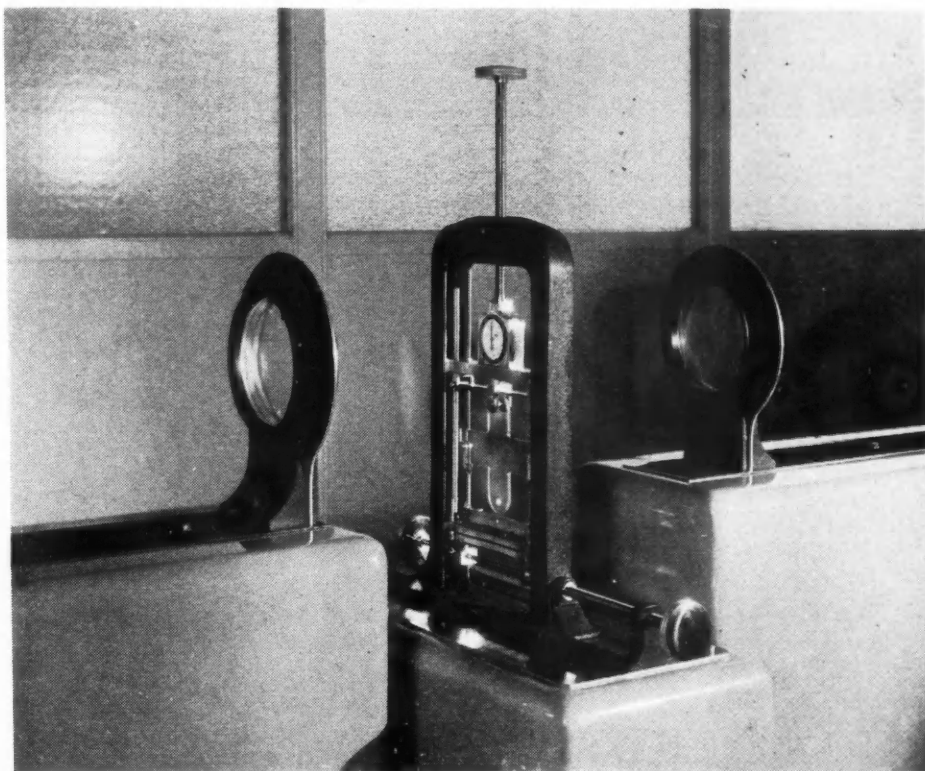






Fig. 3—Sample preparation table. Jig saw, polishing machine, vertical mill, annealing oven

photoelastically the relationship between the press or shrink-fit (in 0.001 in.), and the maximum stress; also the effect of radially drilled holes in hubs and shafts, such as balance or set screw holes.

### Helical and Leaf Springs

As to the stress studies in automobile springs a photoelastic technique can be effectively applied if satisfactory plastic replicas can be made.

Front end suspension springs are subjected to two forces: the dead load and the transverse load. This combination produces a stress distribution which is difficult to analyze mathematically.

The rear axle leaf springs also require an accurate stress determination. By laboratory life tests it has been found that an axial groove cut in each leaf shifts the neutral axis closer to the tension side, thereby producing a more uniform stress distribution. These grooves are now in our production springs.

The photoelastic method can be also applied to stress studies of valve springs, compression and tension springs, and the interleaf pressure of a spring system.

### Threaded Connections

It is commonly agreed that conventional threaded connections do not give maximum fatigue strength. This is largely due to the fact that in bolt and nut design a uniform load distribution is frequently assumed, a condition seldom encountered in practice. As a result, high stress concentrations frequently take place.

The numerical value of these stresses is affected by so many factors that the stress pattern is very complicated and consequently

a theoretical analysis of the problem is of a doubtful value. Photoelastic analysis, however, provides a more satisfactory solution. If studied two-dimensionally comparative stress distribution in different thread designs can be obtained.

In order, however, to determine the stress intensity directly a three-dimensional study is necessary.

Some of the problems involving threaded designs, which are of particular interest to the automotive engineer, are:

- Relationship between the axial dimension and the strength of the screw.
- Relationship between the size of the shaft and the root diameter of the thread.
- The effect of thread base-rounding on stress distribution.
- Methods of relieving stress concentration in bolt threads.

### Welded Joints

In the automobile frame and body several different types of jointed connections are used, ranging from simple bolts and rivets to complicated butt and lap welds. The relative merit of various joints is still a subject of debate, so that in the design of a jointed connection the so-called standard practice is still the prevailing criterion.

Many mathematical attempts have been made to determine the stress distribution in industrial fastenings but in the majority of cases the results are not fully satisfactory even in the simplest type of weld.

Photoelasticity represents an effective approach to this problem. Some of the weld problems in which an automobile engineer is particularly interested are:

- Stress concentration due to the incomplete penetration of welds.
- Stress concentration due to abrupt changes in the weld cross-section.
- Stress distribution in built-up welded joints.

### Stresses at Free Boundaries

Stresses at the free boundaries represent probably the most fruitful field of application for photoelastic science. Under this heading  
(Turn to page 68, please)

Fig. 4—Straight fillet

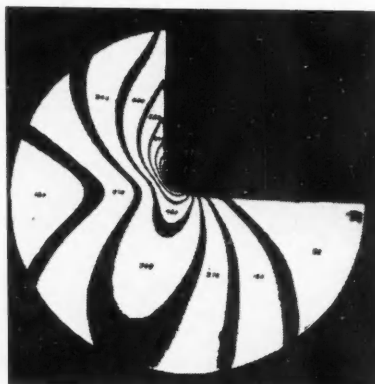
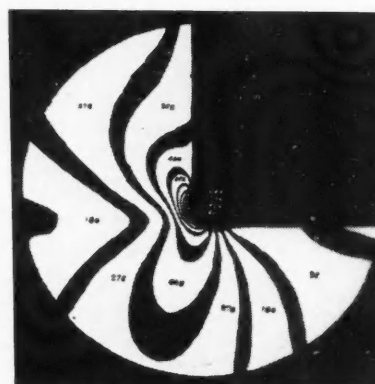


Fig. 5—Undercut fillet



Typical problem solved by means of photoelasticity. For equal radii, stresses in a straight fillet and in an undercut fillet are similar.

## WHAT THE INDUSTRY IS DOING

[ Our own view of automotive production and sales;  
authoritative interpretation of general conditions ]

**P**ROBABILITY that the annual model changeover period will be shorter than usual this year appears certain as the 1941 model run nears its Aug. 1 termination. With the OPM setting Aug. 1 as the beginning of the production quota system to apply to 1942 model production, most manufacturers anticipate a quick changeover in order to begin turning out the new models as soon as possible and stock up their dealers. The uncertainties of the materials situation, the absence of major

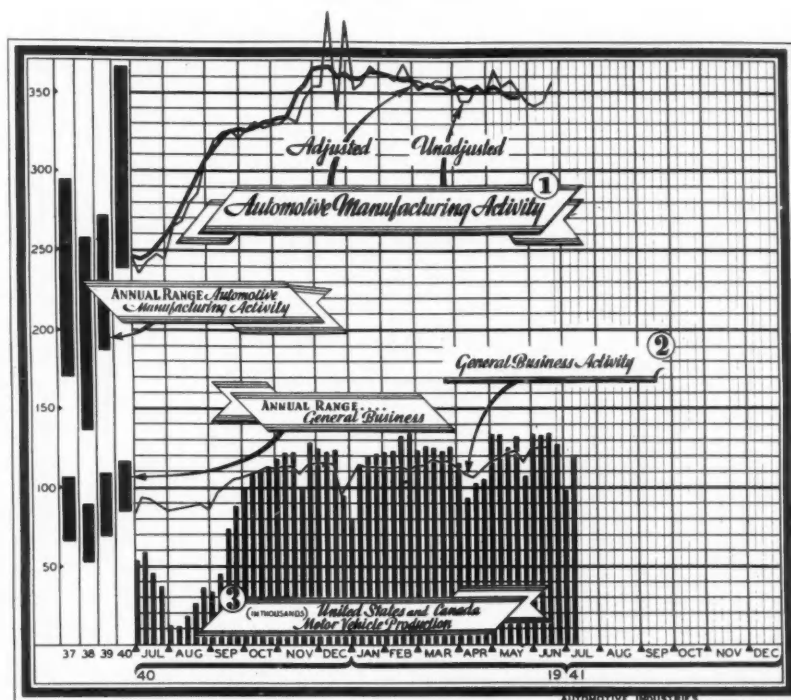
changes in 1942 models and the continual threat of a further production cut than the 20 per cent now imposed on the coming model year, all have combined to hasten the annual retooling.

Output for the first half of July is estimated at 240,000 units. Although July undoubtedly will see a lower production total than any month since September, 1940, it still will be the biggest July since 1937, when output was 456,909 vehicles. One company, which built 3600 units last July, has 28,000 scheduled this year. Production is expected to slack off considerably at the end of the month, most manufacturers winding up 1941 model activities by July 25.

One company expects to go into 1942 model final assemblies immediately upon cessation of '41 production. Other companies will somewhat curtail the usual two to four-week shutdown between models. First of the 1942 model introduction is anticipated late in July, with Hudson expected to be the first to show its new creation.

At a meeting of automobile industry executives

<sup>1</sup> 1923 average = 100; <sup>2</sup> Prepared by Administrative and Research Corp. of New York. 1926 = 100; <sup>3</sup> Estimated at the Detroit office of AUTOMOTIVE INDUSTRIES.



Weekly Indexes of Automotive General Business

## Only Short Period for '42 Model Changeover

arbitrary edict, but by operation of priorities on men and materials. W. S. Knudsen, director of OPM, is opposed to any premature curtailment which would cause unemployment and dislocation of industry before defense projects are ready to absorb the men and materials thus made available.

Appointment of James S. Adams, executive vice-president of Colgate-Palmolive-Peet Co. and former vice-president of Johns-Manville Corp., as coordinator for the industry, working with a 19-man committee composed of automobile and parts company executives, is expected to help smooth the way toward greater cooperation between defense and consumer production. The motor car industry has 11 committee members, while 8 members are from the parts and equipment suppliers.

Leon Henderson, Administrator of OPACS, plans to hold conferences with manufacturers with a view to setting a ceiling on 1942 model prices following his unsuccessful effort to have Chrysler rescind its 1941 model price raises. Six companies raised prices due to higher labor and material costs. Chrysler pointed out that its average increase of \$26.72 per car com-

(Turn to page 61, please)

with OPM officials early in July, it was indicated that the industry will be called upon to divert more and more of its labor, materials, factory space and engineering talent to the constantly growing defense program. The industry may be called upon to treble the \$2-billion in defense orders it already has received. The ramifications of such an expansion make predictions plausible that 1942 model production will be cut as much as 50 per cent for the first half of the model year, not by

# Monroe Methods in

**F**OUNDED 24 years ago by C. S. McIntyre, The Monroe Auto Equipment Co., Monroe, Mich., is a prominent member of the great parts producing segment of the automotive industry, is one of the principal suppliers of direct acting low-pressure shock absorbers and sway bars, has one or more of its products on practically every passenger car made in America.

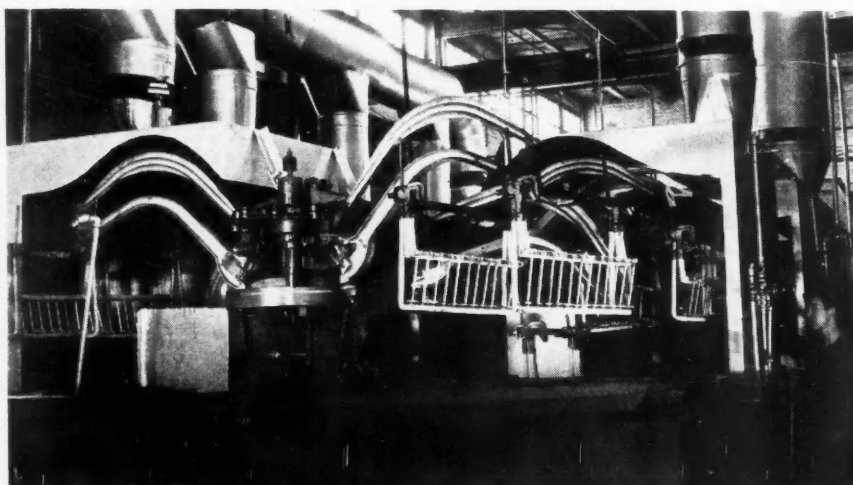
In the modest sized plant in Monroe, operated by B. D., W. D., and C. S. McIntyre, Jr., sons of the founder, are produced an amazing variety of special-

ties including shock absorbers, sway bars, sway bar connectors, tire pumps, jacks, brake and clutch pedals, struts, tire tools, and Spraytex plastic deadening compound.

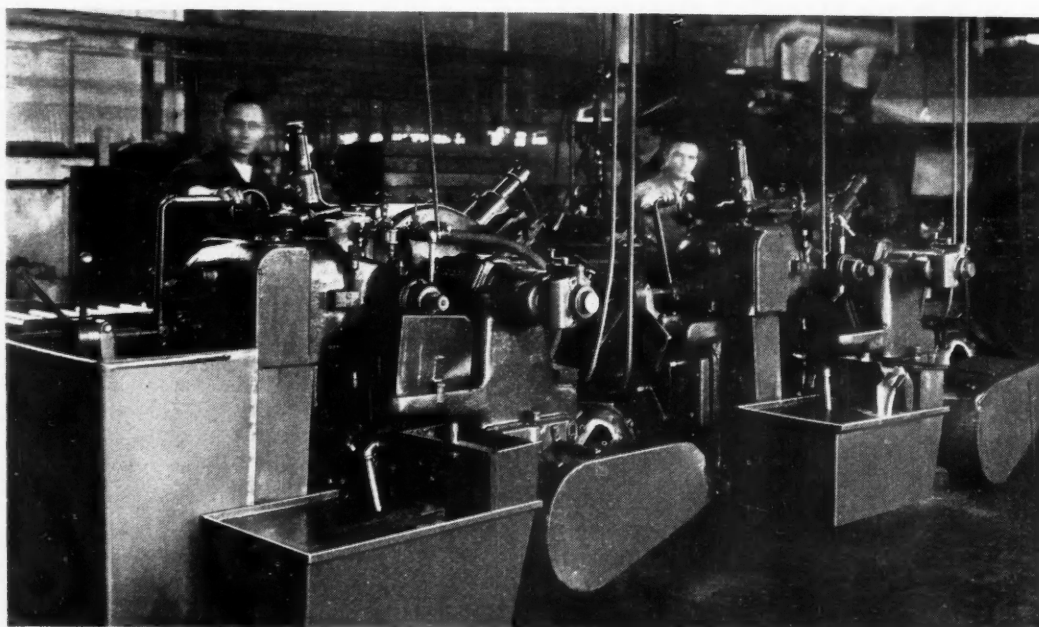
Growing acceptance of Monroe products made it necessary for the management to embark upon an expansion and modernization program last year, adding a new building of modern construction which stepped up the available floor space by 45,000 sq. ft. Total floor space now amounts to 120,000 sq. ft. Coincident with this was the acquisition of many items of productive equipment, including an overhead monorail conveyor 1200 ft. in length, which traverses the entire plant, serving as a feeder line for machine shops, for assembly lines, and as a storage bank for the shipping dock.

Among the new items of equipment is a new chromium-plating machine made by F. B. Stevens; a Yoder tube mill with a capacity of 12,000,000 feet of tubing per year; Cincinnati centerless grinders and a Cincinnati lapper; resistance welding machines; and many other items. The sway bar department has been expanded in capacity to 1,300,000 units per year by the introduction of new heat treating equipment, adoption of automatic bending machines, added press facilities.

Latest developments in the shock absorber line include a



*Close-up view of the Frederic B. Stevens automatic plating machine which is employed in the chromium plating of piston rods. It has a productive capacity of about 1000 rods per hour.*



*Part of the battery of Cincinnati centerless grinders, supplemented with new Cincinnati lapping machine used for grinding and lapping piston rods in preparation for chromium plating.*



# Parts Manufacture

large three-inch unit for railway cars, found on the finest trains of six leading railroads; and a new two-inch unit which was announced recently for application on motor trucks and buses. The entire gamut of shock absorber models comes off the same flexible production line.

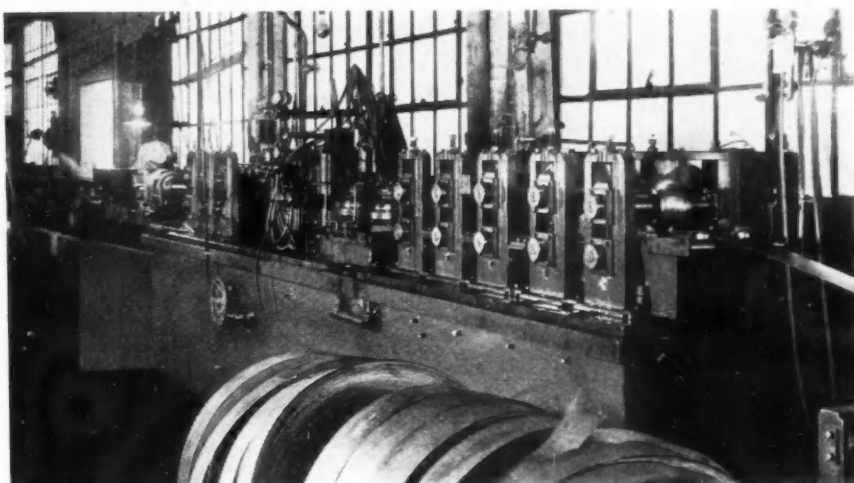
In the manufacture of shock absorbers, the principal functions of each type of unit are controlled by laboratory specifications, these characteristics being expressed in the form of a standard indicator card issued by the laboratory. Performance of all production units then is checked at various stages against a similar master metal card mounted on the machine. This marks a unique kind of quality control procedure.

As an example of the procedure, one of the early operations is that of installing the compression valve. The valve discs are pressed in place on a Toledo press and the diaphragm action checked against a master indicator card. Again, just before the unit is sealed as a complete assembly, it is checked against an indicator card on a special testing machine.

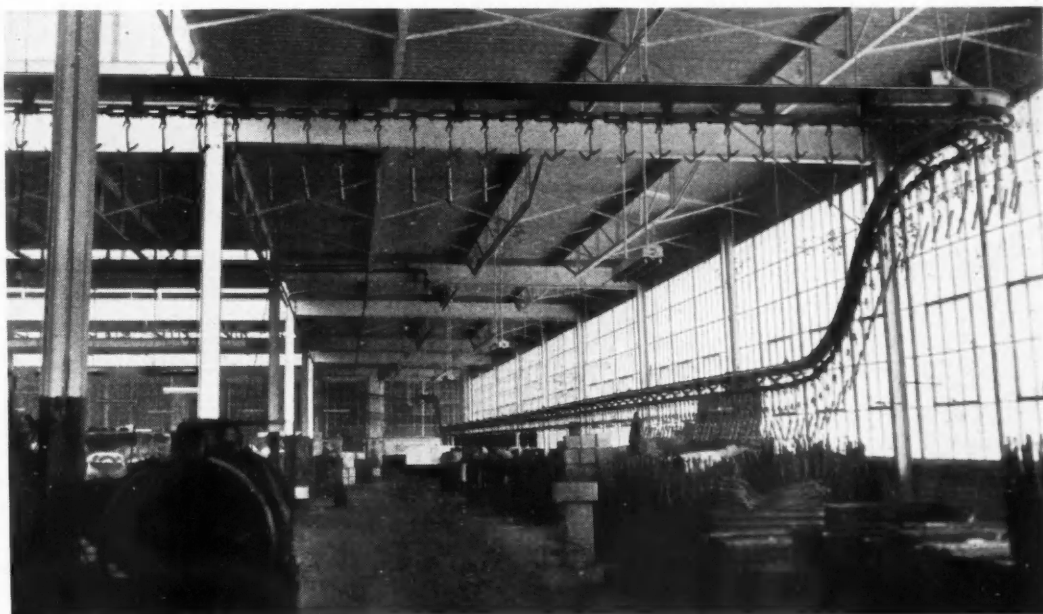
The first step in the manufacture of the shock absorbers is the production of welded steel tubing on the Yoder tube mill. The mill is well provided with a variety of tooling to handle the various sizes used in the plant, ranging from  $\frac{5}{8}$  in. to 3 in. in diam-

eter. In addition, the versatility of a tube mill makes it possible to produce special tubing for outside customers where certain special sizes may not be readily available in warehouse stock. The tubing for shock absorbers is cut to proper lengths on a DeWalt high speed cut-off saw and made ready for the machine line.

Up to a short time ago, the end of the pressure tube was sealed by welding an extra cup onto the open end. More recently, they have developed a process for cupping the end of the tube directly from the parent



*Yoder tube mill shown here produces almost 12,000,000 feet of tubing per year, in a range of sizes from  $\frac{5}{8}$  in. to 3 in. in diameter.*



*Looking down an aisle in the new building. Note particularly the 1200 ft. monorail conveyor which starts in the machine shops and traverses every section of the new building.*

metal, thus producing not only better-looking appearance but an improved job functionally, at lower cost. This operation is performed rapidly on a horizontal machine in which the end of the tube is heated to a high temperature by an impinging flame, then is traversed by a forming tool which draws the plastic metal into a full cup form which, at the same time, becomes permanently sealed through the puddling action of the flame. From this operation the pressure tube goes to a small press where the cup end is coined to an accurate form.

Wherever possible, resistance welding—mostly projection welding—is employed for the joining of parts

of the shock absorber. One important example of this technique is the welding of the connecting eye to the ends of the shock absorber units.

Another of the hidden but vital elements—the piston rod—is given a lot of special treatment to assure high quality and lasting wear and corrosion resistance. In the first place, the long rods are centerless ground to accurate size by passing through two or more Cincinnati centerless grinding machines, then through a new Cincinnati lapping machine which gives it a fine surface finish. The rods then are plated directly on the steel in a new automatic chromium plating machine built by Frederic B. Stevens. This applies a

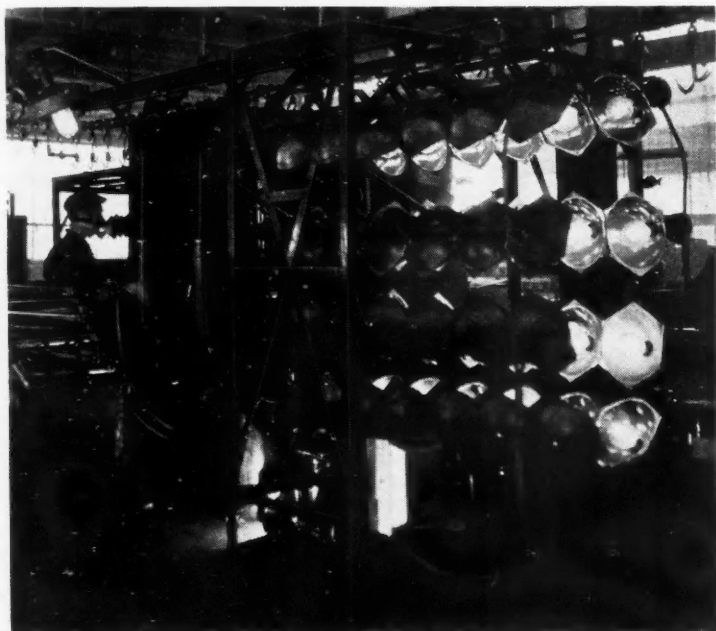
heavy coating of "hard" or mechanical chromium plate of excellent surface quality since it reproduces the basic ground and lapped finish. After plating, the rods are buffed and polished on an automatic attachment.

The Stevens automatic plating machine mentioned above is of universal type familiar to readers of *AUTOMOTIVE INDUSTRIES*, has a productivity of 1000 rods per hour. Plating time in the chromium bath is about 20 minutes for a deposit of 0.0003 in. or 0.0006 in. on the diameter. They employ a current density of 1½ amp. per sq. in. with an impressed voltage of around 5 volts. Interesting commentary on the quality of the plating job is the fact that no appreciable variation in the thickness of the coating at any point on the circumference of the rod has been detected by the conventional methods of testing.

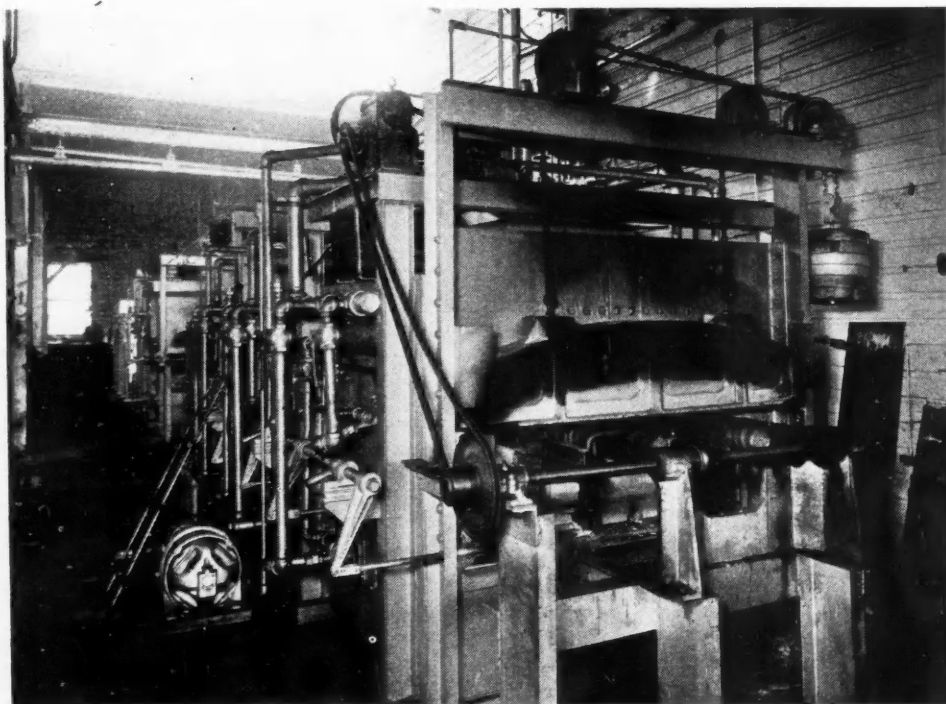
The complete cycle of automatic operations of the plating unit is as follows:

Electro Cleaner .....	1 Min.	10 Sec.
Acid Etch .....	1 "	30 "
Cold Water Spray .....	3 "	0 "
Chrome Plate .....	20 "	0 "
Drainage ..	3 "	0 "
Cold Water Rinse .....		36 "
Hot Water Rinse .....		36 "

Sway bars constitute an important activity, Monroe being the largest producer of sway bars and connector links, making currently about 13 different varieties. The manufacture of sway bars is an exceedingly technical affair, since the units are made not only in special sizes and forms to suit specific makes and models of chassis, but are prepared from a variety of

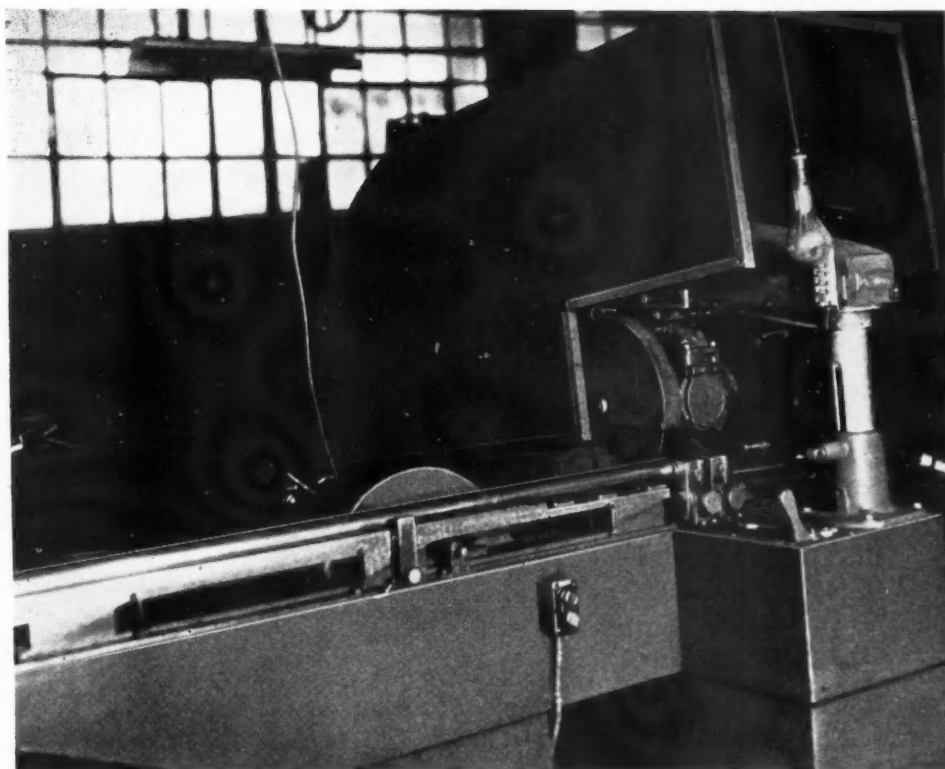


*Baking tunnel composed of infra-red heat lamps is found in the tire pump department. It is used for pre-heating the pumps just prior to the paint spraying operation at the extreme left.*



*One of the gas-fired Surface Combustion Corp. furnaces installed in the sway bar department for heat treating the Monroe sway bars.*

*A high speed DeWalt cut off saw is used for cutting tubing into lengths required in shock absorber production.*



steels, depending upon the user's specifications. The latter characteristic makes it necessary to exercise careful metallurgical control, marks the reason for the adoption of the accurately timed and thermostatically controlled Surface Combination furnaces.

Initial operation on sway bars and braces is the upsetting and forging of the ends or eyes. For this purpose, the bars are heated to the proper temperature in small Surface Combustion, gas-fired furnaces, upset and then forged on board hammers. The bars next proceed to the larger heat treating furnaces preparatory to bending to form in the automatic bending machines.

One of the Surface Combustion units installed several years ago, consists of a hardening furnace, automatic quench, and draw furnace all in line. Both the hardening and draw furnaces are direct gas fired.

In both the hardening and draw furnaces, the conveyor consists of a pair of alloy screws. The bars are manually loaded upon extensions of the conveyor screws at the charge end of the furnace. From the hardening furnace, the bars are discharged onto skid rails and slid into the quenching tank. The quench tank conveyor carries the bars from the quenching medium and deposits them on the screw conveyor of the draw furnace.

This unit can also be used for normalizing. Extensions are fitted on the screws of the hardening furnace and the work instead of being quenched is air-cooled. Capacity of the unit is 1040 pounds per hour heated from cold to 1650 deg. F. This is equivalent to approximately 130 bars per hour.

The second installation was placed in operation in the latter part of 1940 and consists of only a hardening furnace. This furnace is similar in construction to the hardening furnace of the first installation. However, it is designed to accommodate bars up to 72 in. long, conveyed crosswise through the furnace.

The first installation was designed to accommodate bars only 48 in. long. More recently, extensions have been made in the side walls of this furnace to allow longer bars to be passed through.

Near the discharge end of the second furnace, the conveyor screws deposit the bars onto a fast speed au-

OMATIC discharge mechanism which, in turn, deposits the bars onto an apron leading to a quenching machine. The length of the furnace permits 1 in. diameter bars to remain in the furnace for a total of 60 min. Capacity is 130 bars, 1 in. in diameter and 72 in. long, heated from cold to 1650 deg. Fahr in one hour. This corresponds to approximately 1040 net lb. per hr.

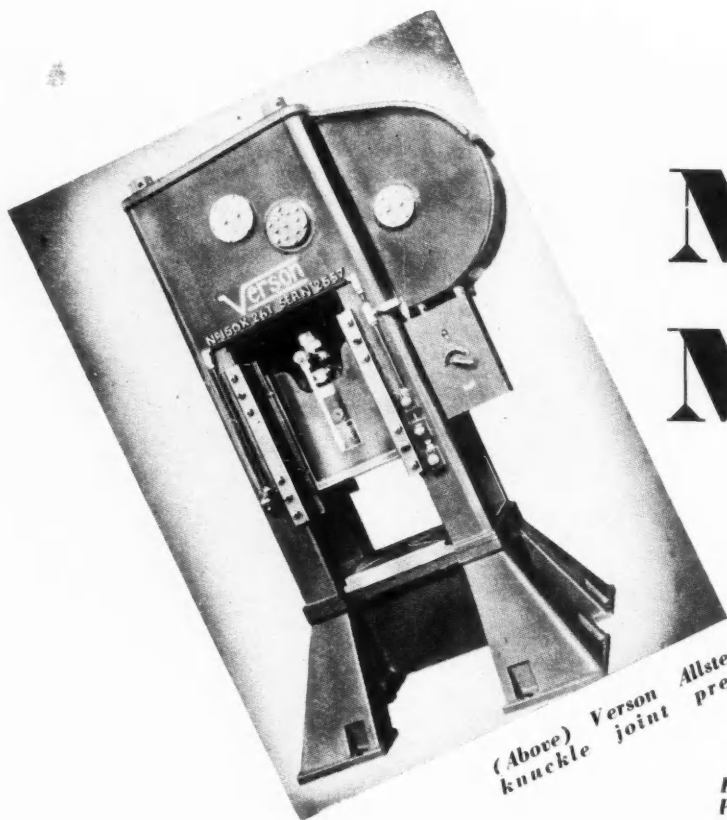
The tire pump department is a self-contained unit in the new building, takes care of the manufacture of a standard line for the accessory field and for export. One of the interesting features of the set-up is the use of a baking oven tunnel made up of infra-red heating lamps for pre-heating the assembled pumps immediately prior to paint spraying. The pumps move along on a monorail conveyor through the baking tunnel, through the spray booth, then are elevated ceiling high on the conveyor for a trip through a long ceiling mounted gas-fired baking oven.

The tire tool, a specialty made for one of the large motor car producers, is made from strip stock in successive passes through a line of punch presses where it is formed and punched. Then the piece is cadmium-plated ready for shipment.

Another interesting feature in the new building is a short gravity roller conveyor assembly line devoted to the assembly of the connector links. More than two million of these links are produced annually.

In Sweden, where charcoal is largely used in metallurgical operations, the Government has put pressure on manufacturers to develop automotive gas generators to burn wood. Among Swedish concerns manufacturing automotive gas generators is the Electrolux company, which lost a large part of its former export market through the blockade.





(Above) Verson Allsteel joint press.

# MEN and MACHINES

**I**LLINOIS TOOL WORKS, Chicago, has developed a new broaching system to provide greater speed and accuracy in that method for rifling machine gun and rifle barrels. All units were designed under the supervision of the company's engineers, including broaches, broaching machines, broach sharpening machines, and broach inspection fixtures.

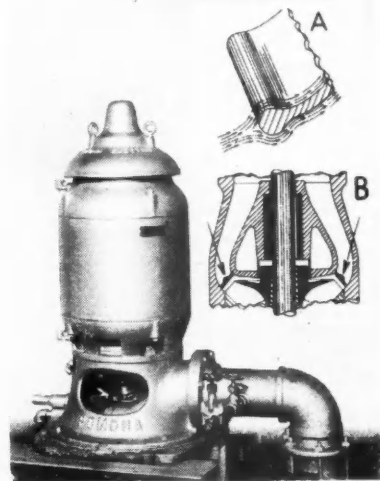
The broaching machine is a screw type machine with the screw driven through V-belts by a reversible motor. The free floating, ball bearing jaw type puller contains a safety link which protects the broach against breakage. The by-pass valve of the high pressure coolant unit is set between 150 and 300 psi., depending on the size and length of the barrel. All oil flows through a filter. The broaches are pulled through the barrel and produce their own lead. The cutting lubricant is supplied under high pressure.

The principle of the rifling broach sharpening machine is similar to that of other broach sharpening machines. The rifling broach inspection fixture provides for visual inspection through a microscope of 20 X magnification. The sizes and steps of the broached teeth are checked by a snap-gage indicator arrangement. Visual inspection of the broaches determines if they have remained free from pick-up. (Illustrated on the facing page.)

**A** NEW welding machine, which is designed particularly for airplane welding, is announced by Lincoln Electric Co., Cleveland, Ohio. Most important of the features is its system of welding current and voltage control, which permits finely accurate settings. Another feature is the current range and capacity of

Pomona Vertical Pump equipped with new type guide vanes.

A—Bulbous shaped end of guide vane.  
B—Cross section of bowl assembly. Arrows indicate location of guide vanes.



the machine. Suited for welding the lighter gages of aircraft steels, the unit delivers 10 amp. at the arc without extra attachments, and its range also adapts it for heavy materials.

The new welder is of motor-generator, single-operator, variable voltage type with laminated pole pieces. Connections are readily accessible for either 220 or 440 volts (also supplied for 550 volts or special voltages), 3 or 2-phase. It is available in two models, 150 and 200-amp. sizes, either portable or stationary. Current range for the 150-amp. model is 10 to 200 amp. and for the 200-amp. model 10 to 250 amp. (Illustrated on the facing page.)

**M**ANUFACTURED in a series of models with capacities of 0.1 to 10,000 hp. at speeds up to 25,000 r.p.m., a new dynamometer of the hydraulic absorption type is being offered by the Taylor Mfg. Co., Milwaukee, Wis. Exceptionally high efficiency is claimed for this machine due to the method of rotor and stator construction, and its mounting on the trunnions.

The capacity is determined by the number of rotors built into the machine. The intake water to each rotor

compartment is controlled by needle valves, and a chain-operated system of exhaust porting gives close control of the water circulated and hence the temperature rise in the water in the casing. This dynamometer operates on the principle of a controllable volume of water, rather than against a head of water. (Illustrated on this page.)

**V**ERSON ALLSTEEL PRESS CO., Chicago, has added to its line of presses a new type knuckle joint series featuring long stroke and long adjustment. These new presses are available in a full range of tonnage. The size illustrated here has a capacity of 150 tons, a 5-in. stroke and a 5½-in. adjustment. The bed size is 26 by 26 in. and the press operates at a speed of 50 strokes per min. It is equipped with full pneumatic operation. Various types of feed can be adapted to the machine. (Illustrated on the facing page.)

**I**MPROVEMENTS to reduce hydraulic losses, thereby increasing their efficiency as much as 10 per cent, have been incorporated in all sizes of Pomona Vertical Turbine Pumps made by Pomona Pump Co., St. Louis, Mo. They involve fundamental design changes in the guide vanes for altering the flow direction of the fluid. By forming the advanced vane ends of bulbous shape, Pomona engineers found they could obtain greater uniformity of flow pattern.

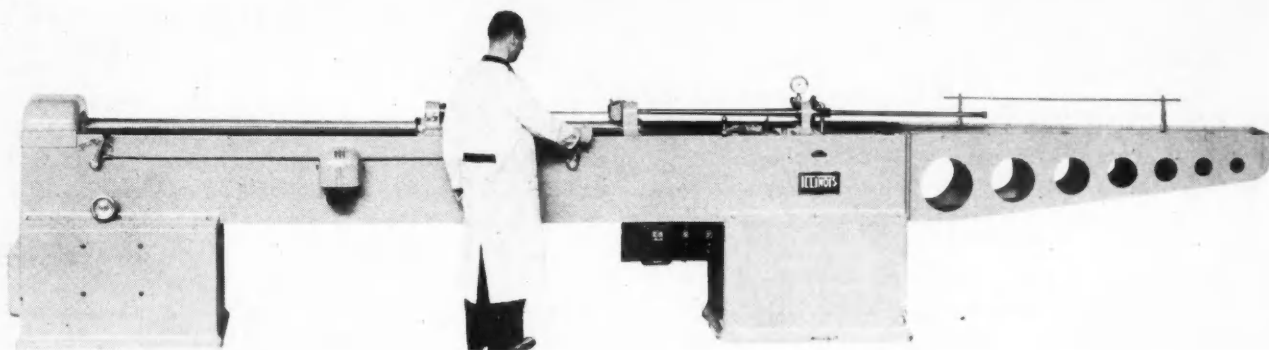
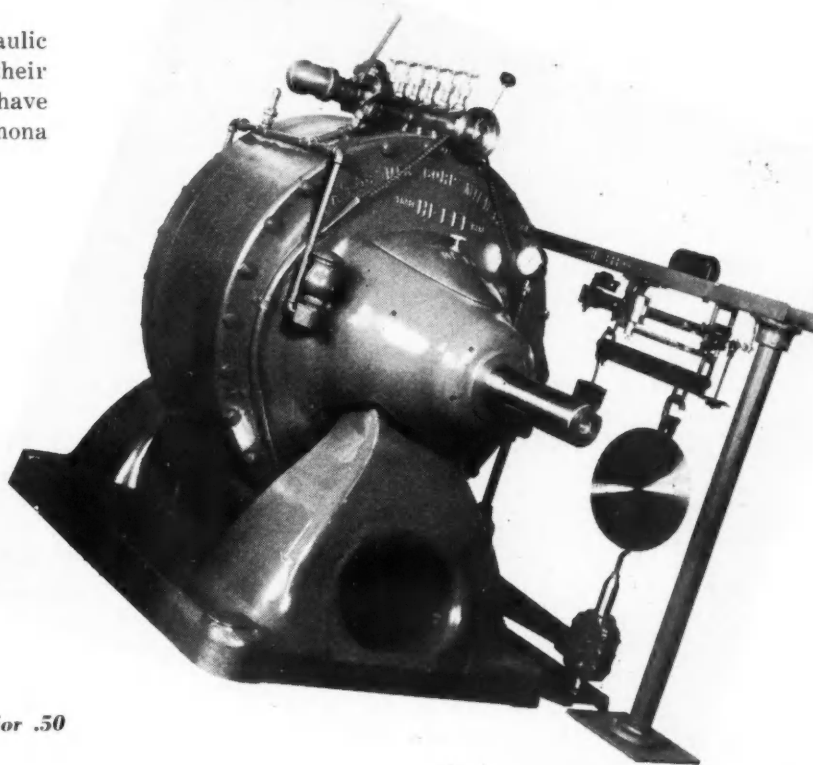
(Turn to page 64, please)

(Below) Illinois Broaching Machine for .50 cal. machine gun barrels.

(Top) Lincoln aircraft arc welder.



(Below) Taylor Hydraulic Dynamometer.



# Automotive MATERIALS

## 53

### **Aluminum Co. Commended for Full Co-operation**

**R**EPORTING on its National Defense investigation, the House Military Committee exonerates the Aluminum Co. of America of any blame for the critical aluminum situation existing in this country. Rather it describes the recent attempt of an Administration official to inject the monopolistic controversy at this time as a "tragic and sorry spectacle." Regarding the aluminum problem, the committee says:

"There has also been a neglect in increasing the facilities for the making of pig iron and steel, principally because we could not or would not give definite assurance to industry as to what it might expect from a wartime expansion of its plants. The situation in regard to aluminum is more critical still.

"The aluminum industry relies on power—electric power. The unwillingness of some Government officials to provide hydro-electric energy from its own dams in such an emergency as exists today is at least shortsighted. . . .

"All the testimony given before this committee was to the effect that the Aluminum Company of America had given 100 per cent co-operation, had not only used its own money for expansion and lowered the price but of its own initiative took steps to treble its production."

### **Wayne Adds Lubricants for Aluminum Operations**

**I**NTRODUCTION of two new lubricants for drawing and machining aluminum and its alloys has been announced by Wayne Chemical Products Co., Detroit. No. 4 Aluminum Drawing Oil is a viscous lubricant claimed not to "squeeze out" under great pressures in deep drawing thin sheets of that metal. The other product, No. 2 Aluminum Cutting Oil, is a thin oil for machining purposes.

### **New Lead-Base Bearing Alloy**

**A** NEW lead-base bearing alloy was described in a paper read before the American Society for Testing Materials at its recent annual meeting in Chicago by Albert J. Phillips, Albert A. Smith, and Paul A. Beck, all research metallurgists of the American Smelting and Refining Co., Barber, N. J. The alloy, which contains 12.5 per cent antimony, 3 per

cent arsenic, and 0.75 per cent tin, is said to be at least equal to the present commercial tin-base alloy in practically all of its physical properties. Additions of small amounts of copper, bismuth, cadmium, nickel and mercury developed no serious loss in

desirable properties, from which it is concluded that the alloy is quite insensitive to impurities or contaminating elements, a feature that is of considerable commercial importance.

The addition of arsenic to lead-base bearing alloys results in improved high-temperature properties and considerable refinement of grain. It has been claimed also that it reduces the friction coefficient of such bearing alloys.

Test specimens in the "as cast" condition showed a Brinell hardness of 22. Brinell hardness tests made at 86 deg. Fahr., on test specimens that had been subjected to 300 deg. Fahr. for seven days showed 20.5 Brinell, and on specimens that had been subjected to this same high temperature for 46 days, 19.5 Brinell. Hardness tests made at 300 deg. Fahr. showed 10 Brinell after the specimens had been subjected to the temperature for 17 hours, 9.7 Brinell after they had been exposed for seven days, and 9.3 Brinell after they had been exposed for 46 days.

Tensile tests on specimens in the "as cast" condition showed a tensile strength of 9800 psi at 77 deg. Fahr., 6700 psi at 212 deg. Fahr., 4200 psi at 300 deg. Fahr., and 1900 psi at 392 deg. Fahr. The elongation in 2 in. rose from 1.5 per cent at 77 deg. to 70 per cent at 392 deg.

The commercial value of any bearing alloy can be materially influenced by the composition stability of the alloy under normal conditions of operation. For example, an alloy containing elements which readily volatilize or oxidize to form dross and thus change the composition significantly are looked upon with disfavor, because of the necessity of constantly checking compositions. Consequently, a series of comparative dressing tests were conducted on lead babbitt, tin babbitt and the new alloy. All samples were melted and held at 750 deg. Fahr. for 30 min., during which period the molten metal was agitated with a stirrer. The composition stability of the new alloy was found to be most satisfactory, and its rate of dross formation was found to be relatively low. In fact, the authors claimed that the alloy is far easier to handle in the molten state than any bearing alloy tested.

Tests conducted on an R.R. Moore fatigue-testing machine indicated high fatigue strength, and tests in a flexure-test machine showed such a marked improve-

(Turn to page 65, please)



## NEWS OF THE INDUSTRY

### Over 600 Labor Disputes in Michigan First Half of '41

*Less Than 10 Per Cent Reached Strike Stage; Employment and Wage Rates Continuing Upward in Detroit and Ohio*

Value of labor conciliation was emphasized recently when it was revealed that 18 Federal and State conciliators in Michigan had helped settle more than 600 labor disputes in the first six months of 1941. In 500 cases, strike notices had been filed, but only 43 disputes, or less than 10 per cent, reached the strike stage. Only four disputes were referred to the National Defense Mediation Board — those at General Motors Corp., Ex-Cell-O Corp., Bohn Aluminum & Brass Corp. and the Sealed Power Corp.

Reports of the Michigan Dept. of Labor & Industry indicate the amount of overtime work required by the Defense program. Payroll disbursements of 1035 Michigan plants in May increased 16.4 per cent over April, while the total employees rose only 1.4 per cent. Compared with May 1940, payrolls this May were up 53 per cent and employment gained 20.8 per cent. Average weekly earnings in the automobile industry for May were \$45.29 compared to \$37.04 in April and \$34.13 in May 1940. The machine tool industry was the only one to show a higher average of \$48.18.

Detroit industrial employment neared an all-time peak in the first half of June, with 432,000 hourly workers in factories, a contra-seasonal gain of 9000 workers from May 31. This total has been exceeded only in February, April and May 1937, when many plants were making up time lost by strikes.

#### Cleveland Index Sets Record

A survey by the Ohio Bureau of Unemployment Compensation in 10 cities showed that employment in industries having direct Defense contracts had advanced 22.2 per cent in a year, rising from 279,204 workers to 341,008. By the end of 1941 a further gain of 23.4 per cent is anticipated, with employment expected to total 420,841 in these plants. The industrial index of the Cleveland Chamber of Commerce reached an all-time peak in June of 125.3 compared to a 1929 high of 112.9.

A recent agreement between the Budd Wheel Co. and the UAW-CIO provides an 8-cent an hour wage increase, with a proviso that wage rates are frozen for 12 months unless the U. S. Dept. of Labor index shows that

the cost of living has risen 5 per cent or more by Jan. 1, 1942, in which case wage negotiations can be reopened. The settlement of the dispute at the Bohn Aluminum & Brass Corp., which was decided before the Defense Mediation Board, also provided an 8-cent an hour wage raise and the freezing of wage rates until April 1, 1942. Gar Wood Industries, Inc., averted a strike by granting an 8-cent an hour raise and the fixing of rates until Jan. 27, 1942.

#### Recent Wage Raises

Other recent hourly wage raises in the automotive industry included: Detroit Gear & Machine Co., 5 cents; Allis Chalmers Mfg. Co., Milwaukee, 5 cents to 10,000 workers; Electric Auto Lite Co., Toledo, 9 to 10 cents to 6000 employees; Ainsworth Mfg. Co., Detroit, 8 to 10 cents; Goodyear Tire & Rubber Co., Akron, 7 to 8 cents to 10,000 workers; Cleveland Tractor Co., 5 cents and

(Turn to page 61, please)

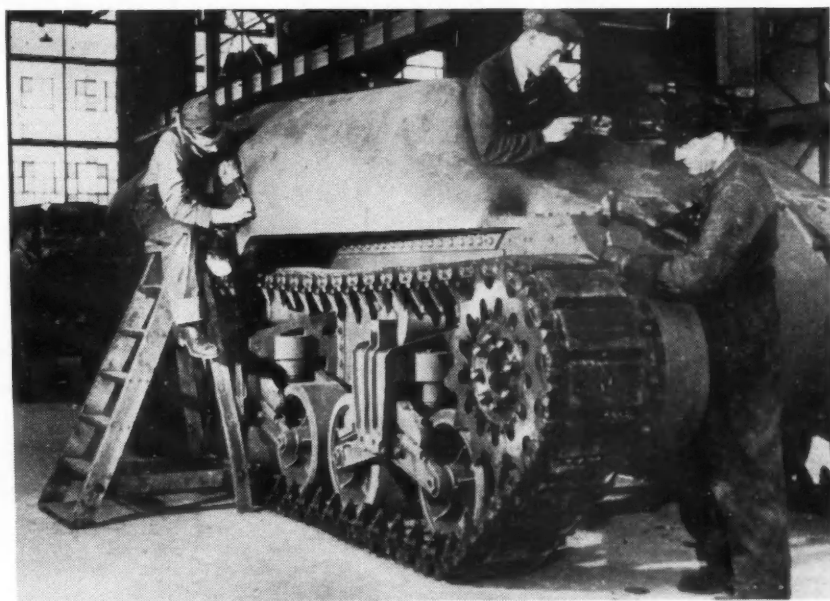
### Name 11 Members of OPM Industry Advisory Group

Approval of 11 of the 19 members of the Automotive Defense Industry Advisory Committee is announced by OPM and in addition the formation of a Motor Truck Subcommittee. The 11 members will represent the manufacturers of passenger cars, trucks, buses, taxicabs and fire fighting equipment. The remaining eight members, which are to represent manufacturers of automotive parts and components, have not been approved as we go to press and are to be announced later. The 11 appointments are as follows:

R. I. Roberge, Ford; Donaldson Brown, General Motors; B. E. Hutchinson, Chrysler; Paul Hoffman, Studebaker; George W. Mason, Nash-Kelvinator; Joseph W. Frazer, Willys-Overland; A. E. Barit, Hudson; W. F. McAfee, International Harvester; E. J. Bush, Diamond T; R. F. Black, White; and R. P. Page, Jr., Autocar.

The following have been appointed to the Motor Truck Subcommittee: M. E. Coyle, Chevrolet-General Motors; L. D. Cosart, Dodge-Chrysler; R. E. Burns, Ford; Charles T. Ruhf, Mack; I. B. Babcock, Yellow Truck & Coach; E. J. Bush, Diamond T; W. F. McAfee, International Harvester.

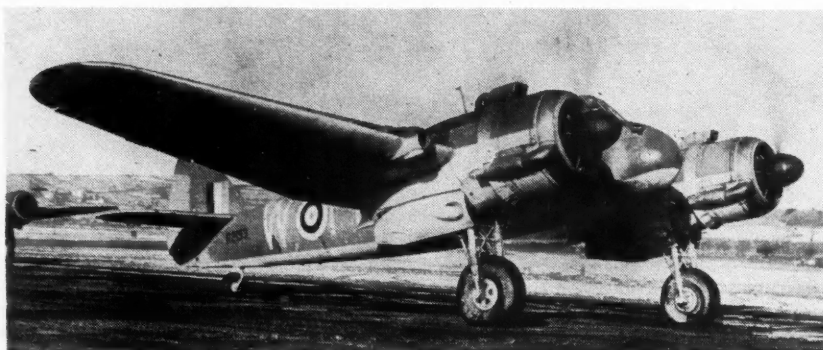
(Turn to page 48, please)



Acme

#### New Version of M-3 Tank

Engineers of America, Britain and Canada contributed to the design of the new Canadian M-3 tank, the pilot model of which is shown being built at Montreal Locomotive Works. Its hull and turret are single steel castings each instead of riveted armor plates like on the American tank. The 75-mm. cannon is mounted on the turret.



British-Combine

### On Guard for Britain

Suitable for use as a day or night interceptor, this Bristol Beaufighter is from the same stable as the famous Blenheim. Its fairly high speed combined with long range and heavy armament makes it especially formidable at night.

## Army Acquires Airport Near Detroit for Warplane Base

### *Armament Will Be Installed There on Bombers; Industry Prepares for Larger Schedule of Aircraft and Engines*

Acquisition of the Wayne County Airport on the western outskirts of Detroit by the U. S. Army as a base for equipping and distributing bombing planes emphasizes the increasing importance that the motor car industry and Detroit have taken in the National Defense program. The Army already has taken over the 272-acre airport with its hangars and machine shops preparatory to active use. Air Corps officers from Wright Field are supervising the changeover to an Army base. A force of 200 civilian and enlisted mechanics will be employed and troops will be stationed at the field for guard duty.

Bombing planes will be flown to the airport from various factories to have their armament installed. Such armament includes hydraulically operated gun turrets being made by Superior Tool & Die Co., Detroit, aerial cannon to be manufactured by Oldsmobile at Lansing and machine guns as made by AC Spark Plug and Saginaw Steering Gear divisions of General Motors. The airport also will serve as a distribution point for Army bombers.

#### **Ford Plant on 975-Acre Tract**

The Wayne County Airport is only eight miles from the new Ford bomber plant now under construction at Willow Run, near Ypsilanti. The Defense Plant Corp. recently allocated \$47,620,171 for the expansion of this plant, which will have an area of 2,547,000 sq. ft., or more than 58 acres, making it the largest one-story building in the U. S. This exceeds the 2,120,000 sq. ft. in the new Wright Aeronautical Corp. plant at Lockland, Ohio. The Ford plant is on a 975-acre tract, and an airport, including hangars, will be built adjacent.

Expansion of the Ford airplane en-

gine factory at the Rouge, 21 miles from Willow Run, also has been authorized by the Government with award of an additional \$13,870,000 to the \$21 millions already allotted to the building that is nearing completion. This will be accomplished by extending the rear of the plant 400 feet, which will increase total floor space to 1,188,000 sq. ft. This addition was accompanied by an order for 4807 more Pratt & Whitney 2000-hp. radial engines totaling \$138,811,739. This brings total orders to 9043 engines costing \$261,134,759. Engine production will begin within 60 days and a rate of 15 per day is expected to be attained by next January.

Award of a Government contract for \$166,261,526 to the Glenn L. Martin-Nebraska Co. was followed by sub-contracts for \$42 millions to Chrysler Corp. and \$12 millions to Hudson. Chrysler will build the nose and center fuselage sections for the Martin B-26 bombers to be assembled at Martin's new Omaha plant, while Hudson will make the rear fuselage sections. Goodyear Aircraft Corp. also will share in this order.

Fisher Body of GM will supply more than \$62 millions in airframe parts for the North American B-25 bombers to be assembled at Kansas City, Kan. The Fisher Memphis Aircraft Division will be the focal point for Fisher Body's share of the 100-bombers per month program, working principally on flat sheet metal and assembly operations. Ternstedt Mfg. Division in Detroit will supply die castings. Three other Detroit Fisher units will share in the work, Plant 23 doing machine work on forgings, Plant 37 making deep drawn stampings and Plant 21 welding parts for the sub-assemblies.

Chevrolet's share in the airplane engine program was announced with receipt of a Government order for \$89,075,000 for building and equipping plants at Buffalo and Tonawanda, N. Y., to produce an initial 5000 Pratt & Whitney 1200-hp. motors. All Chevrolet's automobile activities will be transferred out of the Buffalo area.

#### **Chevrolet Tonawanda Plant**

The Tonawanda plant, with a capacity of 65 automobile engines per hour, will be converted to aircraft, with 800,000 sq. ft. available. This will center all Chevrolet's automobile engine activity at Flint. A new plant containing 300,000 sq. ft. will be built adjacent to the motor plant for test cells, shipping and final assembly. The Buffalo assembly plant, eight miles distant, will become aviation engine plant No. 2. This contains 581,000 sq. ft. The Buffalo motor car production, which turned

(Turn to page 58, please)

### Industry Advisory Group

(Continued from page 47)

ternational Harvester; Fred T. MacRae, White; and T. R. Lippard, Federal.

One of the first duties of the new Advisory Committee will be to discuss with OPM the amount of additional curtailment and the means of making it without creating unemployment and "wasteful shutdowns."

To triple the defense orders for the automobile industry, which is indicated by OPM officials, production for the 1942 model year will have to be limited to between two million and three million units, according to reliable estimates.

#### **Committee Chairman**

James S. Adams, chief of the OPM Automotive Commodity Section, has been designated by the Government as the presiding officer of both the Automotive Defense Industry Advisory Committee and the Motor Truck Subcommittee.

Associate Director Sidney Hillman has announced that a Labor Advisory Committee, to be selected from labor organizations in the automotive field, is being planned for advising OPM on all problems affecting labor in the automotive industry.

#### **Bernard G. Koether**

Bernard G. Koether, former sales executive of General Motors Corp., died June 9 in Detroit at the age of 63 years. Having entered the automobile industry in 1901, he became vice-president in charge of sales and assistant general manager of Hyatt Roller Bearing Co. in 1920. When Hyatt joined General Motors in 1923, he was made director of the GM sales division. In 1934 he was appointed director of customer relations and retired in 1939.

## CALENDAR

### Conventions and Meetings

Natl. Petroleum Assoc., Atlantic City, Sept. 17-19  
Society of Automotive Engineers, National Tractor Meeting, Milwaukee, Sept. 25-27  
Natl. Lubricating Grease Inst., Chicago, Sept. 29-30  
Natl. Safety Council, Chicago, Oct. 6-10  
Exposition of Power & Mechanical Engineering, Chicago, Oct. 6-11  
American Welding Society, Philadelphia, Oct. 19-21  
Amer. Society of Tool Engineers, Toronto, Canada, Oct. 16-18  
SAE Natl. Fuels & Lubricants Mtg., Tulsa, Okla., Oct. 23-24  
American Society for Metals, Philadelphia, Oct. 20-24  
Society of Automotive Engineers, Aircraft Production Meeting, Los Angeles, Oct. 30-Nov. 1  
SAE West Coast Transportation Mtg., San Francisco, Nov. 5-6  
SAE Natl. Transportation & Maintenance Mtg., Cleveland, Nov. 13-14  
National Assoc. of Manufacturers, New York City, Dec. 3-5

### Shows

Automobile Accessories Association Show, Chicago, Aug. 4-7

## ASI Show Changed to Third Week of February

Next year's Automotive Service Industries Show is scheduled for Atlantic City Feb. 16 to 21 instead of February 23 to 28. Decision to this effect has been announced by the joint operating committee making arrangements.

The change was voted by the committee to an earlier week to avoid holiday crowds at Atlantic City on Washington's birthday, which will be largely observed February 23 since the day itself falls on Sunday next year.

## Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE INDUSTRIES

Continuing acceleration of general business activity was indicated at the mid-year. The seasonally adjusted index of *The New York Times* for the week ended June 28 rose to 132.8 per cent of the estimated normal, an all-time peak, as against 131.4 for the preceding week and 109.6 a year ago. The index of *The Journal of Commerce*, without adjustment for seasonal variation, for the same period registered a similar maximum, 124.7 per cent of the 1927-29 average, as compared with 123.3 a week earlier.

Department store sales during the fourth week of June, according to the Federal Reserve compilation, exceeded by 23 per cent the corresponding total last year; and for this year to June 28 sales were 14 per cent above the comparable 1940 figure.

Contracts awarded for heavy construction during the week ended July 3, according to *Engineering News-Record*, totaled \$74,209,000, equivalent to little more than half the preceding weekly amount, but 135 per cent greater than that a year ago.

The movement of railway freight increased more than seasonally during the week ended June 28 to the highest level since 1940. Loadings totaled 908,664 cars, 2.6 per cent more than in the week before and 20.7 per cent above the comparable number last year.

Electric power production in the same period rose to an all-time peak, 17.3 per cent greater than the output a year ago, as against a similar gain

of 15.2 per cent for the third week of June.

Business failures during the week ended July 3 numbered 216, as compared with 229 in the preceding week and 259 a year ago, according to the Dun & Bradstreet report.

Crude oil production in the week ended June 28 averaged 3,847,250 barrels daily, 10,350 barrels less than the average a week earlier, but 17,250 barrels above the required output computed by the Bureau of Mines.

Average daily production of bituminous coal for the same period was 1,833,000 tons, as against 1,717,000 tons in the preceding week and 1,343,000 tons a year ago.

Cotton mill activity in the fourth week of June increased contra-seasonally; and *The New York Times* adjusted index rose to 194.9 per cent of the estimated normal, as compared with 187.1 a week earlier and 122.0 for the corresponding period last year.

Professor Fisher's index of wholesale commodity prices, registering the first decline since March 10, stands for the week ended July 3 at 94.3 per cent of the 1926 average, as against 95.1 for the preceding week.

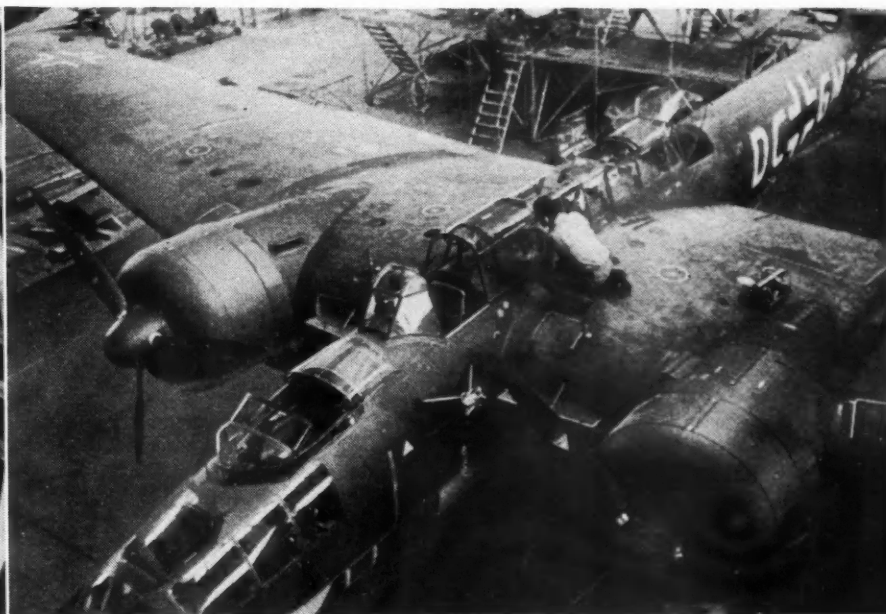
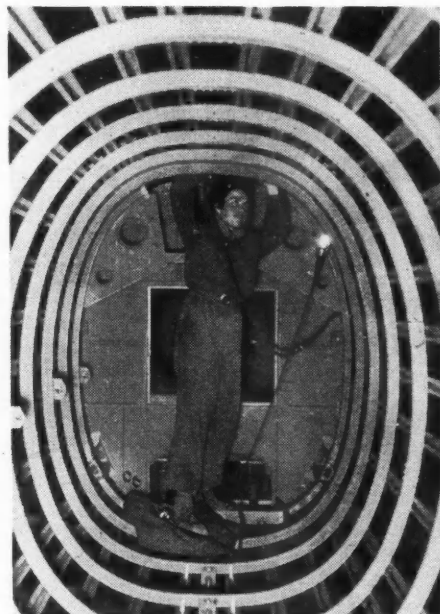
Member bank reserve balances increased \$140 millions during the week ended July 2, and estimated excess reserves rose \$120 millions to a total of \$5270 millions. Business loans of reporting members increased \$70 millions and stood on that date \$1457 millions above the corresponding amount last year.

### Samuel L. Anker

Samuel L. Anker, superintendent of shipping for Ford Motor Co., died suddenly June 8 at his home in Detroit. He was 52 years.

### Arthur H. Watson

Arthur H. Watson, a patent attorney for a number of years with the Borg-Warner Corp., Chicago, died July 1 at the age of 45 years.



### Heinkel He-115 Bomber

This Heinkel He-115 twin-engine bomber is about to join the Luftwaffe's long-range striking power. The pictures were taken on the production line from unusually close vantage points. Note the liberal use of transparent plastics.





### Latest in Bombers

Possibly the world's fastest bomber in its class, this Martin 187 "Baltimore" is a mid-wing, deep-waisted design, is powered by two Wright 1600-hp. engines, and carries a crew of four. It has heavy firepower and a power-driven gun turret. Production is scheduled in a few weeks.



Norton Co., Worcester, Mass., has named **Paul Fielden** director of purchases. **John Miller** succeeds him as credit manager.

**Henry Wilder**, of Heald Machine Co., Worcester, has been appointed regional chairman for the Worcester, Mass., district of the Emergency Defense Training Committee, American Society of Tool Engineers.

**Robert J. Minshall**, vice president of the Boeing Airplane Co., Seattle, has resigned to become president of Pump Engineering Service Corp., Cleveland, a Borg-Warner subsidiary. Minshall, who had been with Boeing since 1918, will succeed **D. E. Gamble**, who continues as vice president and general manager of the Borg & Beck Division of Borg-Warner Corp.

**Howard W. Jordan** has been named president of the Pennsylvania Rubber Co., Jeanette, Pa., succeeding **A. C. Powers**, who resigned recently. Jordan formerly was vice president and comptroller of Montgomery, Ward & Co., with whom he had been associated for 30 years.

Sealed Power Corp. has transferred **Leon Toll** to the Southwest District from the Southeast District, which will be handled by **W. A. Edwards**.

**Earl R. Southee**, chief of the Standards Division of the C. A. A. pilot training ser-

vice, was honored at the Twelfth Annual National Soaring Contest which was held this month in Elmira, N. Y. One of the days was designated "Earl Southee Day".

**Dr. Arthur S. Adams** has been appointed assistant dean of the College of Engineering at Cornell University.

**Nash-Kelvinator Corp.** has created a new post, that of vice president in charge of sales, and **Frank R. Pierce** will fill it. **Charles T. Lawson** will succeed Mr. Pierce as general sales manager of the corporation's Kelvinator Division. Other appointments include that of **E. Ray Legg** as sales manager of household appliances to succeed **Lawson**, and that of **Don Rulo**, successor to **Legg** as western sales manager.

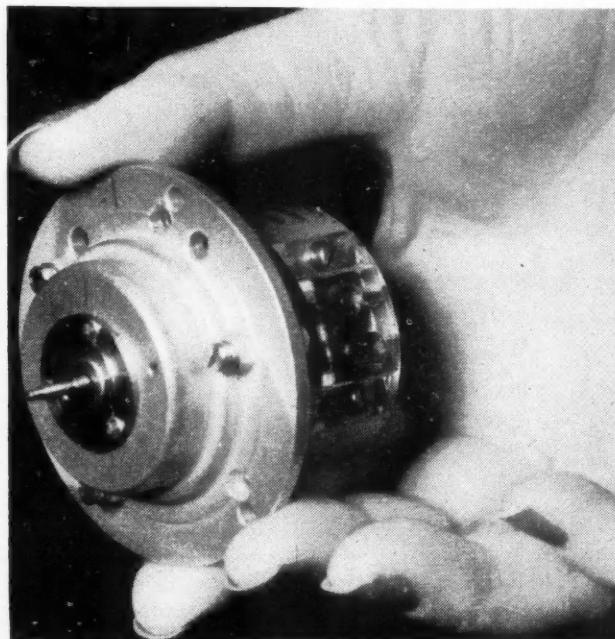
**E. B. Headden** has been elevated to the executive vice presidency of Purolator Products, Inc., from his former position as vice president. Other appointments are as follows: **S. Letzler**, vice president and comptroller; **Frank P. Herman**, vice president in charge of equipment sales; **John M. Clarke**, vice president in charge of distributor sales; **L. W. Williams**, vice president in charge of engineering, and **Jules Kovacs**, chief engineer.

**Arch Warner** has been promoted to assistant works manager of the Mechanics Universal Joint Division, Borg-Warner Corp., Rockford, Ill.

**Henry M. Hogan** and **Frederic G. Donner** have been elected vice presidents and members of the Administration Committee of General Motors Corp. Mr. Hogan has been assistant general counsel and Mr. Donner general assistant treasurer.

### Vital Autosyn Motor

Watchlike in size and precision, several hundred of these tiny Autosyn motors are turned out daily by General Motors' Delco division at Rochester. In multiple installations of as many as 20-odd in one airplane, the function of this seven-oz. motor is to "tell" the pilot the exact position of many moving parts of his ship.



## CENSORED—

An exclusive feature prepared by the London correspondent of AUTOMOTIVE INDUSTRIES, M. W. Bourdon.

Among the recipients of the King's Birthday Honors is Patrick Hennessy, general manager of the Ford Motor Co. since January, 1939. He becomes Sir Patrick Hennessy, receiving a knighthood.

\* \* \*

The requirements of modern city traffic are ignored by Lord Quickwood in discussing the replanning of London. He "views with alarm" suggestions that after the war the City of London should be built "more spaciouly." He considers that the peculiar charm of the city has depended essentially upon the labyrinthine character of its thoroughfares, its network of narrow and sinuous streets; to substitute wide avenues for these would be a vandalism worse than bombing, he says.

\* \* \*

With the death of R. D. F. Paul, the motor industry has lost three of its outstanding personalities within the same number of weeks. First Lord Austin, then Laurence Pomeroy and now, in "Bob" Paul, at the age of 69 years, one of the best known and most popular among representatives of motor journalism on its advertising side. Originally associated with *Motor World*, Glasgow, and then with the publishers of *The Autocar* (London), Paul joined the Temple Press *Motor*, and Commercial Motor in 1906 after an interval in U. S. A.

\* \* \*

The Associated Equipment Co. has standardized three freight and two passenger models for its "10 per cent civilian sales" scheme sanctioned by the Ministry of Supply. All have the A.E.C. 7.7 liter direct injection six-cylinder oil engine developing 90 b.hp. at 1700 r.p.m. The freighters range in load capacity from 8 to 16 long tons and consist of four, six and eight-wheelers. The bus chassis are single-deck and double-deck models.

\* \* \*

An effective and safe substitute for ordinary glass, where complete transparency is not essential, is a new material known as Luxoid introduced by a London firm. It is termed "flexible glass" and is said to consist of woven glass fabric with the texture running horizontally and impregnated with clear synthetic resin. The finished material is 1/16 in. thick, and although tough, it can be cut with knife or shears.

\* \* \*

The Board of Trade has taken powers under a new bill that enable

## FROM BRITAIN

it, among other things, to require every dealer in used cars to be registered, and to prohibit the sale of used cars except by registered persons. Although the bill is intended primarily to control the charges for furniture storage, boot repairing and laundry work, it is so framed as to give control of maximum prices and charges for service in respect of all commodities other than food, the Ministry of Food already having full powers in connection with the latter.

The Motor Agents' Association is discussing post-war reconstruction, and Divisional sub-committees formed to put forward recommendations as to a post-war trading policy are said to be making good progress with their undoubtedly formidable task. Their greatest difficulty obviously is the fact that nobody can forecast prevailing conditions in the motor industry after the war, so much depending upon how long the war lasts and the financial state of the community in general.

The motor industry of England, Scotland and Wales is raising a fund to pay for a fighter squadron for the Royal Air Force. The aim is to collect £100,000 and of this over £85,000 had already been obtained, largely from distributors and dealers, by the end of June.

Between 70 and 80 double-deck Leyland buses originally intended for export have been diverted to English operators, by order of the Ministry of Supply, to meet urgent requirements due to increased traffic, not only in London but also in the provinces, where the problem of transport for the ever-expanding army of munition workers has become increasingly acute. The use of the buses mentioned has been sanctioned despite their being wider overall than is strictly legal in England.

The manufacture of a limited number of 10 hp. four-passenger four-door salons has been put in hand by Morris and Hillman for the home market. But they will not be available for the public in general. Their production has been authorized by the Ministry of Supply to meet essential war needs and they will be allotted by the Ministry of War Transport solely in fulfillment of that aim. The price of the Morris has not been fixed but the Hillman is to be £250 plus Purchase Tax, approximately £70. Thus the total cost will be about £320, as compared with £192 at the outbreak of war.



### Partly Self-Perpetuating

This year Pontiac is making 70,000 of its 200,000-ton foundry output from its own scrap. The workman with the shovel is adding briquettes of steel and iron scrap and chips to a "batch" in the charging bucket. The other workman is adding a rejected cylinder block. Each ingredient is measured for the exact proportion.

## 40 YEARS AGO

A painful accident occurred here last Sunday, which came very near a tragedy. As a party of semi-invalids were returning home from my office, they met one of those hissing, rattling, puffing, smudging, modern Jugger-nauts, called an "automobile" tearing down a steep grade at high speed.

The horse, although driven by a skillful horseman, became at once unmanageable, ran onto a steep bank, dumped the occupants into the ditch, then ran, completely demolishing the carriage. And it was little short of a miracle that they escaped with their lives.

Any man who will imperil the lives of his fellow beings by running an infernal, unmanageable engine on our public highways, and that solely for

his own selfish, sensuous gratification, is either a fool or a brute. If a fool, he should have a guardian placed over him at once and his dangerous plaything be taken from him; if a brute, he should be—treated as one.

(Signed) Dr. C. A. W.

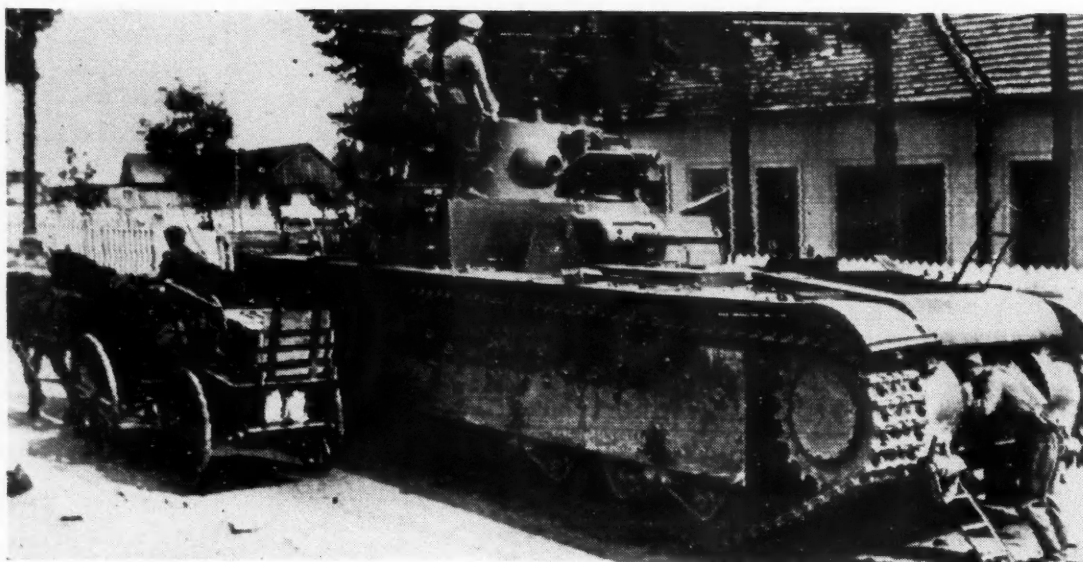
From *The Horseless Age*, July, 1901.

### Truck Production by Capacity (U. S. and Canada)

	FIVE MONTHS		
	Unit:		Per Cent of Total
	1941	1940	1941
1½ Tons and less	453,223	332,499	64.38
2 to 3 Tons	58,756	22,630	10.94
3½ Tons and over	9,323	5,911	1.74
Special and buses	5,584	2,848	1.04
Station Wagons	10,230	8,049	1.90
Total	537,096	371,937	100.00

### Passenger Car and Truck Production (U. S. and Canada)

	FIVE MONTHS					
	May 1941	April 1941	May 1940	1941	1940	Per Cent Change
<b>Passenger Cars—U. S. and Canada:</b>						
Domestic Market—U. S.	408,885	363,867	315,441	1,959,005	1,682,199	+16.1
Foreign Market—U. S.	8,813	11,112	10,235	49,614	59,191	-16.1
Canada	9,840	12,091	12,677	56,661	63,547	-10.7
Total	427,538	387,070	338,353	2,065,280	1,804,937	+14.2
<b>Trucks—U. S. and Canada:</b>						
Domestic Market—U. S.	87,450	74,057	55,340	404,235	285,448	+41.6
Foreign Market—U. S.	13,498	13,234	9,199	62,436	57,054	+9.2
Canada	16,745	15,493	8,600	70,457	29,435	+139.0
Total	117,693	102,784	74,139	537,128	371,937	+44.2
Total—Domestic Market—U. S.	496,335	437,924	371,781	2,363,240	1,967,647	+20.2
Total—Foreign Market—U. S.	22,311	24,346	19,434	112,050	116,245	-3.6
Total—Canada	26,585	27,584	21,277	127,118	92,982	+37.0
Total—Cars and Trucks—U. S. and Canada:	545,231	489,854	412,492	2,602,408	2,176,874	+19.8



Press Association, Inc., Photo

## Russian Goliath

This radiophoto from Berlin shows German soldiers inspecting a heavy Soviet tank abandoned near Lwow in Russian-occupied former Poland. It is believed to be a 52-ton tank.

## PUBLICATIONS

The Fulton Sylphon Co. offers a concise, 28-page catalog, profusely illustrated with application diagrams, on **Seamless Metal Bellows and Bellows Assemblies**, used by instrument, appliance and machinery manufacturers.\*

The June issue of Mainspring, Wallace Barnes Co., contains an article "Design of

"Torsion Springs", supplemented by several charts and a table of specifications.\*

Handy & Harman has issued a new folder, "The Best Joint Designs for Silver Alloy Brazing".\*

Elastic Stop Nut Corp.'s folder on **self-locking nuts** tells how they work — and why.\*

New Departure, Division of General Motors, has just issued the 15th edition of its handbook, listing the principal types and sizes of the **Forged Steel Ball Bearings**. Equipped with a new finger index for quick reference, the book contains dimensions, capacities, tolerances and mounting fits,

also new data to simplify the selection of bearings for various loads and length of service.\*

A folder on **Welding in National Defense** has been issued by The James F. Lincoln Arc Welding Foundation.\*

"Airco in the News", the first edition of Air Reduction's bi-monthly publication, describes pictorially the use of its **oxyacetylene welding and cutting and arc welding equipment**.\*

The Acoustic Division of Burgess Battery Co. has published in pamphlet form an address on Diesel engine exhaust silencing by Mr. Alfred S. Chipley, Development Engineer.\*

Two attractive new booklets by Aluminum Co. of America, one of which is "Aluminum in Aircraft", written to meet the demand for information about aluminum alloys resulting from the expansion of aircraft production. It is intended primarily for the newcomer who wants to obtain a general picture of the use of aluminum in aircraft. The other is "Forming Aluminum", which tells how aluminum alloys are formed by drawing, spinning, embossing and other metalworking processes.\*

The current issue of Grits and Grinds, by Norton Co., contains an article "Increasing 'Wear-Life' by Cylindrical Lapping" and another on **Cutter Grinding Set-Ups**.\*

The June issue of Ex-Cell-O Tool Tips contains two noteworthy articles, "Getting the Most From Broaches" and "Greater Accuracy and Improved Finish".\*

Donaldson Co.'s 25th anniversary booklet tells about its **air-cleaning equipment** for use on tractors and power units for industry and transportation. Its laboratory, maintained for testing air cleaners under all conditions, is also fully described.\*

\*Obtainable through editorial department. AUTOMOTIVE INDUSTRIES, Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

## Detroit Engineers Elect

Officers elected at the recent board meeting of the Engineering Society of Detroit include Harvey M. Merker, Parke Davis & Co., president; Clyde R. Paton, Packard Motor Co., first vice-president; Elwyn C. Balch, Michigan Bell Telephone Co., second vice-president; Prof. Alfred H. Lovell, University of Michigan, secretary; Glenn Coley, Detroit Edison Co., treasurer; T. A. Boyd, General Motors Research Laboratories, assistant treasurer; and E. L. Brandt, managing secretary.

## Exports and Imports of the Automotive Industry for April

	APRIL				FOUR MONTHS ENDED APRIL			
	1940		1941		1939		1941	
	No.	Value	No.	Value	No.	Value	No.	Value
<b>EXPORTS</b>								
Automobiles, parts and accessories.....		\$ 19,493,140		\$ 28,642,095		\$ 96,086,292		\$ 107,138,414
<b>PASSENGER CARS</b>								
Passenger cars and chassis.....	8,041	5,245,130	8,386	5,642,965	41,803	25,839,386	30,462	21,052,473
Low price range \$850 inclusive.....	7,065	4,232,687	7,043	4,246,169	36,812	20,723,822	24,845	15,128,356
Medium price range over \$850 to \$1,200.....	846	811,367	1,156	1,092,701	4,351	4,121,259	4,754	4,549,122
\$1,200 to \$2,000.....	118	172,120	175	256,450	585	849,780	805	1,176,491
Over \$2,000.....	12	28,936	12	47,645	55	144,525	58	198,504
<b>COMMERCIAL VEHICLES</b>								
Motor trucks, buses and chassis (total).....	7,591	5,488,765	9,914	12,009,948	42,617	34,150,712	40,939	40,415,681
Under one ton.....	966	393,126	620	354,644	6,195	2,795,100	2,938	1,524,741
One and up to 1½ tons.....	5,394	3,038,207	6,181	3,790,967	25,914	14,379,241	26,263	16,121,461
Over 1½ to 2½ tons.....	742	812,340	922	1,067,823	7,385	9,889,469	4,550	5,323,736
Over 2½ tons.....	485	1,241,324	2,185	6,769,105	3,022	6,938,244	7,140	17,394,187
Bus chassis.....	4	3,768	6	7,409	101	148,658	48	51,556
<b>PARTS, ETC.</b>								
Parts except engines and tires.....								
Automobile unit assemblies.....		3,615,334		5,962,721		16,224,788		24,732,994
Automobile parts for replacement (n.e.s.).....		3,530,552		3,625,689		14,417,940		14,755,271
Other automobile accessories (n.e.s.).....		392,261		555,589		1,576,881		2,158,048
Automobile service appliances.....		271,237		327,743		1,017,824		1,214,754
Airplanes, seaplanes and other aircraft (powered).....	233	12,862,198	571	47,077,905	795	57,557,403	1,854	120,878,077
Parts of airplanes, except engines and tires (n.e.s.).....		2,845,489		5,266,603		7,721,086		12,485,170
<b>INTERNAL COMBUSTION ENGINES</b>								
Stationary and Portable.....								
Diesel and semi-Diesel (other than automotive).....	94	386,391	343	1,304,517	315	910,800	1,070	4,428,079
Other stationary and portable.....								
Not over 10 hp.....	1,137	67,037	1,953	128,485	5,349	312,477	6,290	412,805
Over 10 hp.....	217	305,647	301	324,503	870	1,102,685	801	1,042,963
Accessories and parts (carburetors).....		344,783		458,543		1,426,107		1,810,086
<b>Engines for:</b>								
Motor trucks and buses.....	1,803	211,673	1,105	165,315	8,446	910,058	8,118	1,217,337
Passenger cars.....	2,612	258,566	179	16,723	8,681	781,612	3,609	424,461
Aircraft.....	358	2,980,568	70	8,223,694	1,297	11,172,726	2,894	35,987,084
<b>IMPORTS</b>								
Automobiles (dutiable).....	62	71,328	50	26,411	200	219,478	126	89,412



*Now*  
**THE KS**  
**SPEEDOMETER**

*Completes the*  
**King-Seeley Line of**  
**Dash Instruments**

The King-Seeley Speedometer, engineered and manufactured to the same high standards as the well-known K-S Electric Telegages (water temperature, oil pressure and fuel level) provides a complete line of dash instruments and places King-Seeley in a position to supply complete cluster assemblies, every unit of which is manufactured in the King-Seeley plant.

Field tests of 250,000 K-S Speedometers for the period of a year has demonstrated characteristic King-Seeley dependability and accuracy.

Write for further information



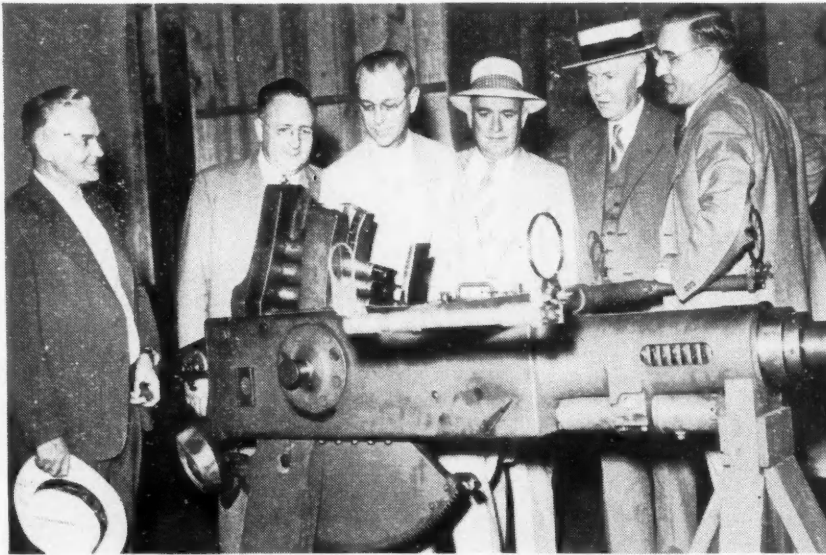
**KING-SEELEY**  
**CORPORATION**

ANN ARBOR MICHIGAN

SUPPLIERS OF ORIGINAL AUTOMOTIVE  
EQUIPMENT SINCE 1922

**KING-SEELEY TELEGAGES**  
**SHOW FUEL LEVEL,**  
**OIL PRESSURE AND**  
**WATER TEMPERATURE**  
*Transmission is entirely by Wire—No Tubes*

OTHER PRODUCTS  
INSTRUMENT PANELS • SPEEDOMETERS • GOVERNORS



### America's Anti-aircraft Gun

Chrysler Corp. officials (left to right): F. J. Morrisette, operating manager of its gun arsenal; A. H. Patterson and D. S. Eddins, Plymouth's vice-pres. and pres.; F. J. Lamborn and W. J. O'Neil, Dodge vice-pres. and pres.; and Herman L. Weckler, Chrysler vice-pres. and general manager, are examining the first pilot model of the Bofors 40-mm. rapid fire anti-aircraft gun made by the corporation. Present schedules call for 300 a month and manufacturing operations will be carried out in nine of its plants in Detroit and Indiana.

## Metal Supplies Far Short of Civilian Requirements

**Early Estimates of OPM Provide Basis for Industries to Chart Future Course; Expect Copper Price Announcement**

By W. C. Hirsch

Slowly the outlines of the situation that will confront metal consumers, once the Defense program has attained desired volume and speed, are beginning to unfold themselves. The very fact that the Office of Production Management has publicized an estimate of the ratios of apparent civilian demand to what remains of the supply, after military needs have been met, indicates that the Defense authorities are eager to dispel as quickly as possible the uncertainty surrounding this problem. Although some of the estimates, such as for instance that of 15 times greater demand for aluminum than the tonnage that will be available for civilian use, will give little comfort to those who had hoped that somehow or other they would be able to obtain the major part of their requirements.

### Alloy Steels

With the exception of plate, the civilian demand for steel is predicted to be only 10 per cent higher than the tonnage that will be available after Army and Navy needs have been taken care of. This estimate refers to plain carbon steel only. As to alloy steel's civilian demand is expected to be twice that of the tonnage to be had for that purpose. Only two out of every five pounds of copper, for which there is civilian

demand, will be available. Nickel consumers will have to get along on one-half of the tonnage they would like to have.

All these ratios, of course, are subject to considerable revision as the result of unforeseen developments. So, for instance, OPM estimates that the civilian demand for tin will be 33 1/3

per cent greater than the tonnage available. Within the last few weeks a concerted movement to substitute silver for much of the tin used in solders has gotten under way. It remains to be seen how this will affect tin consumption for civilian manufactures. Then again, a period of relatively light shipping losses would add considerably to the available stock of tin. And once tin, smelted from Bolivian ores in the United States, a plan now approaching realization, is available, pressure should be further lightened.

### Full Priority Control on Chromium

These estimates of the extent of metal supplies for civilian industries have raised the hope that while "business as usual" is out of the question, sufficient material for keeping peacetime industries of economic importance going will be obtainable.

In adding chromium to commodities under full priority control, Defense officials rounded out the list of important constituents of the principal alloy steels. Latest revision of steel ceiling (Turn to page .66, please)

## Mechanical Engineers Nominate Officers for '42

The American Society of Mechanical Engineers has announced nominations for its 1942 officers as follows: President—James W. Parker, Detroit Edison Co.; vice-president—Clarke F. Freeman, Manufacturers Mutual Fire Ins. Co., Providence, R. I.; Clair B. Peck, Railway Mechanical Engineering, New York; William H. Winterrowd, The Baldwin Locomotive Works, Eddystone, Pa.; Willis R. Woolrich, Bureau of Engineering Research, University of Texas; managers—William G. Christy, Hudson County Court House, Jersey City, N. J.; Herbert L. Eggleston, Gilmore Oil Co., Los Angeles, and Thomas S. McEwan, McClure, Hadden & Orthan, Chicago.

### Estimated Dealer Stocks of New Passenger Cars

	1941	January	February	March	April	May	June
Production—U. S. Domestic Market †	471,774	385,706	398,773	363,867	408,885		
Retail Sales—U. S. ‡	303,564	345,455	449,551	483,116	524,269		
Change in Inventory	+98,210	+40,251	-50,778	-119,249	-115,384		
Inventory, First of Month, 1941	336,550	434,760	475,011	424,233	304,984	189,600	
Inventory, First of Month, 1940	215,856	325,102	412,800	416,281	414,672	399,592	

†—U. S. Census Bureau.

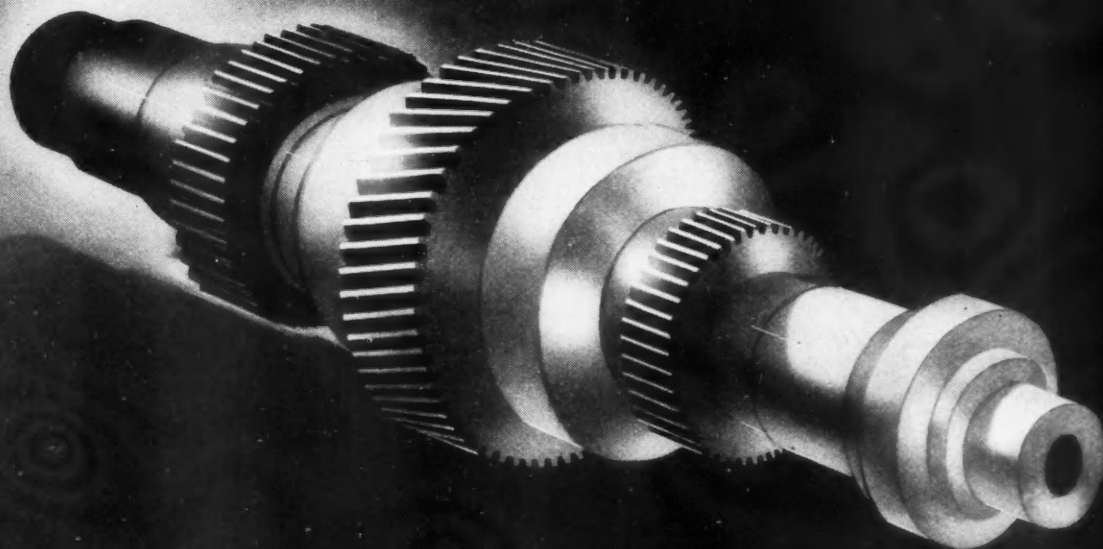
‡—Automobile Manufacturers Association.

### Monthly Motor Vehicle Production (U. S. and Canada)

	PASSENGER CARS		TRUCKS		TOTAL MOTOR VEHICLES	
	1941	1940	1941	1940	1941	1940
January*	423,223	375,476	100,835	74,016	524,058	449,492
February*	495,160	350,535	104,166	71,690	599,326	422,225
March*	422,289	364,947	111,560	75,285	533,849	440,232
April*	387,070	375,626	102,784	76,807	489,854	452,433
May	427,538	338,353	117,783	74,139	545,321	412,492
Total	2,065,280	1,804,937	537,128	371,937	2,602,408	2,176,874
Total for Year		3,802,454		889,884		4,692,338

\*—1941 data revised.

**The best material need not be  
the most expensive. Investigate  
Chromium-Molybdenum Steels.**



One machine tool manufacturer — looking for "the best" in spindle steels — has standardized on Chromium-Molybdenum "4145".

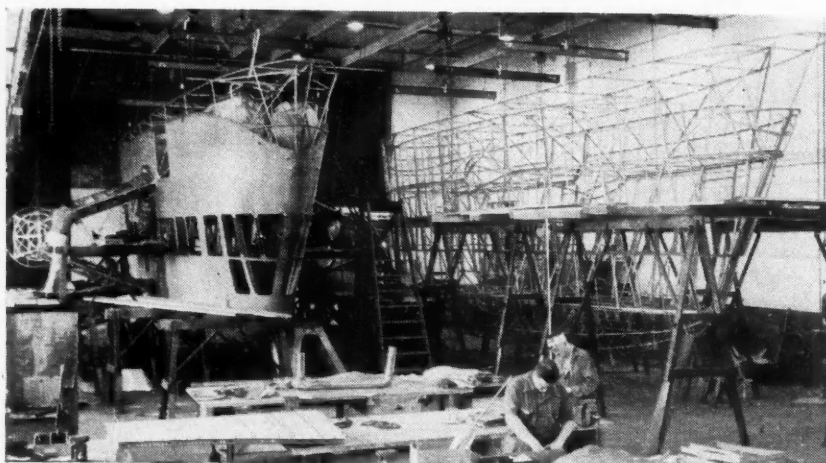
This low cost alloy steel meets the stringent demands of wear resistance and toughness put upon the spindle to produce long-lived accuracy in lathe-produced parts.

Write for our free technical book, "Molybdenum in Steel".

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.  
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • CALCIUM MOLYBDATE

**Climax Molybdenum Company**  
**500 Fifth Avenue • New York City**





### Control Cars for Navy Airships

At its Akron factory Goodyear Aircraft Corp. has production of new non-rigid patrol airships well under way for the U. S. Navy. Shown here are control cars being built for two ships. The car on the left is being covered and outfitted. The metal framework for the other car is at the right.

### Harry J. Gordon

Harry J. Gordon, manager of the Detroit office of the Dryden Rubber Co., died June 26 at his home in Detroit after a long illness. He was 65 years old.

### Knight Morley Corp.

Purchase of the automotive horn division of Schwarze Electric Co. has been announced by Knight Morley Corp., Detroit, manufacturers of automobile accessory equipment.

## BOOKS.....

**AEROSPHERE-1941**, edited by Glenn D. Angle. Published by Aircraft Publications, New York, N. Y.

This well-known publication on aircraft and aircraft engines combined with a statistical material and a directory of the aircraft industry has appeared in a second edition. It is somewhat smaller in size than the first edition, the historical engine material collected under the heading "World's Aircraft Engines" having been omitted. As before, the publication comprises four sections, these being now devoted to Modern Aircraft, Modern Aircraft Engines, Statistics, and Buyers Guide. The sections on aircraft and aircraft engines are well illustrated. The directory or "Buyers Guide" section is not limited to the American aircraft industry, but covers the whole world.

**CROWN SURFACE DEVELOPMENT PROBLEMS**, by George J. Mercer, Detroit.

George J. Mercer, 10347 Linwood Ave., Detroit, well known as a writer on automobile-body topics, has issued another book entitled "Crown Surface Development Problems." It is intended for draftsmen working on automobile bodies, aircraft, and dies and tools. Illustration (drawings) are shown on left-hand pages and accompanying text on the facing right-hand pages. The book is being published by the author.

## March New Passenger Car Registrations and Estimated Dollar Volume by Retail Price Classes\*

PRICE CLASS	NEW REGISTRATIONS								ESTIMATED DOLLAR VOLUME							
	MARCH				THREE MONTHS				MARCH				THREE MONTHS			
	Units		Per Cent of Total		Units		Per Cent of Total		Dollar Volume		Per Cent of Total		Dollar Volume		Per Cent of Total	
	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940
Chevrolet, Ford and Plymouth	223,849	171,771	53.32	55.00	545,095	435,853	53.49	54.68	\$182,000,000	\$131,300,000	47.19	48.76	\$443,022,000	\$333,100,000	52.27	48.30
Others under \$1,000	78,359	100,210	18.67	32.09	187,650	255,750	18.41	32.09	72,400,000	90,700,000	18.77	33.68	83,408,000	231,700,000	9.84	33.60
\$1,001 to \$1,500	110,530	38,354	26.34	12.28	268,015	99,458	28.30	12.48	119,400,000	43,400,000	30.96	16.12	289,752,000	112,700,000	34.19	16.34
\$1,501 to \$2,000	5,860	1,222	1.40	.39	14,957	3,715	1.47	.47	9,200,000	2,100,000	2.38	.78	23,438,000	6,400,000	2.77	.93
\$2,001 to \$3,000	1,126	710	.27	.24	3,284	2,265	.33	.28	2,700,000	1,700,000	.70	.63	7,874,000	5,500,000	.93	.80
\$3,001 and over		18				42			100,000		.03		220,000		.03	
Total	419,774	312,285	100.00	100.00	1,019,001	797,094	100.00	100.00	\$385,700,000	\$269,300,000	100.00	100.00	\$847,544,000	\$689,620,000	100.00	100.00
Miscellaneous	284	86			702	118										
Total	420,058	312,371			1,019,703	797,212										

## April New Passenger Car Registrations and Estimated Dollar Volume by Retail Price Classes\*

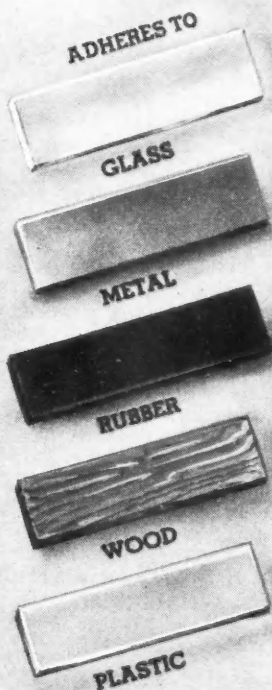
PRICE CLASS	NEW REGISTRATIONS								ESTIMATED DOLLAR VOLUME							
	APRIL				FOUR MONTHS				APRIL				FOUR MONTHS			
	Units		Per Cent of Total		Units		Per Cent of Total		Dollar Volume		Per Cent of Total		Dollar Volume		Per Cent of Total	
	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941	1940
Chevrolet, Ford and Plymouth	248,007	193,319	50.72	54.81	793,102	629,172	52.59	54.72	\$231,900,000	\$147,800,000	45.57	48.48	\$644,922,000	\$480,900,000	49.97	48.36
Others under \$1,000	92,384	111,660	18.90	31.66	280,034	367,410	18.57	31.95	85,400,000	101,000,000	19.27	33.13	168,808,000	332,700,000	13.08	33.45
\$1,001 to \$1,500	139,582	45,269	29.57	12.94	407,697	144,737	27.04	12.59	50,700,000	57,200,000	34.01	16.79	440,452,000	163,900,000	34.13	16.48
\$1,501 to \$2,000	7,458	1,550	1.53	.44	22,415	5,265	1.49	.48	1,700,000	2,700,000	.38	.89	25,188,000	9,100,000	1.95	.92
\$2,001 to \$3,000	1,394	873	.28	.25	4,678	3,139	.31	.28	3,400,000	2,100,000	.77	.69	11,274,000	7,600,000	.87	.76
\$3,001 and over		14				56			70,000		.02		290,000		.03	
Total	498,925	352,685	100.00	100.00	1,507,926	1,149,779	100.00	100.00	\$443,100,000	\$304,870,000	100.00	100.00	\$1,290,644,000	\$994,490,000	100.00	100.00
Miscellaneous	149	554			851	672										
Total	499,074	353,239			1,508,777	1,150,451										

\* All calculations are based on delivered price at factory of the five-passenger, four-door sedan, in conjunction with actual new registrations of each model. The total dollar volumes are then consolidated by price classes.

# GLASS SEALER

TRANSPARENT

SEALS WINDSHIELDS and WINDOWS



Extreme summer heat, sub-zero cold, driving rains or melting snows play havoc with the metal frames of windshields and windows of automobiles.

Loose weatherstripping, loose glass or cracked glass hold water in contact with metal window frames for long periods. Unless water and air are excluded, corrosion will start and will never stop.

The prevention of water seepage under such conditions was an impossible task until the problem was solved by the Research Department of the Permatex Company.

Permatex Glass Sealer forms a transparent bead or film that immediately sets into position, dries rapidly, adheres strongly and remains tough, pliable and waterproof.

Available in 1 ounce and 5¼ ounce tubes.

PERMATEX COMPANY, INC. Sheepshead Bay, N. Y., U. S. A.

## Army Warplane Base

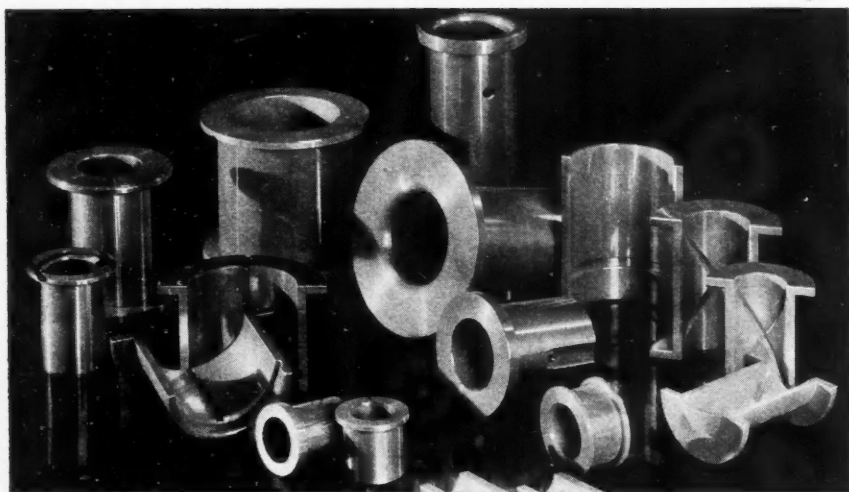
(Continued from page 48)

cut 77,000 vehicles in 1940, will be spread among Chevrolet's nine other assembly plants. The aircraft engine building operation will require about 15,000 men, who will work a six-day week on a three-shift basis.

Chevrolet also will play a more important part in the building of Army trucks. Present Army truck production, which is at the rate of 500-4x4 units per week and has totaled more than 20,000, will be stepped up to 1000 vehicles per week by next Jan. 1. In

addition, Chevrolet will assume some of the production burden of Yellow Truck & Coach Mfg. Co. Chevrolet will assemble 600-6x6 GM truck units per week, beginning next Jan. 1. The division also will supply Yellow Truck with 1300 sets of axles and transfer cases per week, to be built at Detroit and Toledo; 1800 sets of sheet metal, and 1000 sets of transmission gears. Chevrolet also will turn out 900 of the 272 cu. in. GM truck engines per week for the Army.

Aluminum forgings for North American bombers also will be made by Chevrolet at its Muncie, forge plant.



## FLANGED BEARINGS

*to your Specifications*

● Flanges . . . on one end . . . or both ends. In the center . . . or off center. Half bearings . . . full halves or saw cut. Cast bronze—in any alloy . . . cast bronze plus babbit . . . steel and babbit . . . self-lubricating LEDALOYL. Here is a bearing service that will give you exactly what you want . . . any size . . . any type . . . any quantity with no delay.

### for the ENGINEER

Sleeve Bearing Data Sheets, clear, concise, authentic, cover all types of bearings and applications. Write for the complete set.

When you place your bearing requirements with Johnson Bronze you secure the highest quality possible. Skilled workmen plus up to date methods and machinery combine to meet your most exacting specifications.

If you have a bearing problem, a Johnson Engineer will gladly help you solve it. As we produce ALL types of sleeve bearings, we hold no prejudice for any ONE kind. All of our recommendations are based strictly on facts. Why not try Johnson on your next order?



## JOHNSON BRONZE

*Sleeve BEARING HEADQUARTERS*

625 S. MILL STREET • NEW CASTLE, PA.

Buick, which will build the same Pratt & Whitney 1200-hp. aircraft engine as Chevrolet at its new plant under construction at Melrose Park, Ill., has had its original order increased by \$88 millions. This calls for upping Buick's production rate from 500 to 1000 engines per month when this begins next spring. The new program will require Buick to use the old axle plant at Flint for engine parts and will mean the shift of 5000 men from automobile to aircraft work there.

Kelsey-Hayes Wheel Co., which is nearing completion of a \$5,800,000 machine gun plant at Plymouth, Mich., expects to achieve a 75 per day output of .50-caliber machine guns by fall. The plant, originally built for the British, has been taken over by the Defense Plant Corp. under the Lease-Lend Act.

Nash-Kelvinator Corp. has received a letter of intent for \$21,500,000 for jigs and equipment for production of Hamilton Standard propellers in part of the Reo Motors plant at Lansing.

### Packard \$19-Million Order

Packard Motor Car Co. has received an additional \$19-million Government order for 900 of 1350-hp. marine engines to power U. S. and British surface torpedo boats. Packard is nearing completion of an order for 720 of these engines, production of which was begun in Dec. 1939. Current production is at the rate of 3 engines per day, but this will be stepped up to five a day.

Other recent defense orders include \$3,463,640 to International Harvester Co. for Army trucks; \$3,041,616 to Yellow Truck & Coach Mfg. Co. for Army trucks; \$2,028,983 to Diamond T Motor Car Co. for Army trucks; \$15,500,000 to Studebaker Corp. for 6x6 2½-ton Army trucks; \$14,481,088 to Aeroproducts Division of GM, Dayton, Ohio, for propeller assemblies; \$256,670 to Aircooled Motors Corp., Syracuse, for engines; \$527,944 to Gar Wood Industries, Inc., for wrecker and dump bodies; \$775,744 to Fruehauf Trailer Co. for trailers and semi-trailers; \$1,206,960 to Guide Lamp Division of GM for cartridge cases; \$1,214,742 to Mack Mfg. Corp., Allentown, Pa., for wreckers; \$228,540 to Motor Wheel Corp. for artillery ammunition; \$427,000 to Budd Wheel Co. for artillery ammunition; \$4,500,000 to Hayes Industries, Inc., Jackson, Mich., for jigs and equipment to produce airplane wheel and brake assemblies; \$1,543,937 to Continental Motors Corp. for tank and engine parts.

## ADVERTISING

Forrest U. Webster of MacManus, John and Adams, Inc., Detroit, will speak on the subject, "Are Industrial Buyers People?" at the annual conference of the National Industrial Advertisers Association to be held Sept. 17-19 at Toronto, Canada. He is a past president of the NIAA and a former chairman of the advertising committee of the National Electrical Manufacturing Association.



## The Operator Says...

"Mallory Tips cut down redressing . . . and thanks to standardization replacement is a cinch when it is needed."



The man "on the line" does not applaud performance unless it is earned the hard way. That's why Mallory is proud of the reputation Mallory Welding Electrodes enjoy among welding machine operators.

No other manufacturer has approached the investment Mallory has made in its program of standardization . . . but it has been more than justified by the unassailable position of leadership it has won. Mallory Welding Electrodes are definitely better because of standardization. Limitless field experience has definitely established the specific requirements of cooling, design, hardness, electrical and thermal conductivity for each purpose. The result is more welds between redressing . . . and a far greater number of welds between replacements. Standardization has also eliminated costly delays while special orders are being completed. Specify Mallory and save in every direction.



### **MALLORY** Resistance Welding Data Book

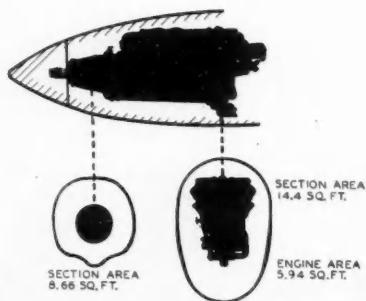
Be sure that your engineering library includes this comprehensive reference to resistance welding practice, alloys and specifications. Write for your copy today.

**P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA** Cable Address — PELMALLO



**P. R. MALLORY & CO. Inc.**  
**MALLORY**  
**RESISTANCE WELDING ELECTRODES**

## Air-Cooled vs. Liquid-Cooled Aircraft Engines



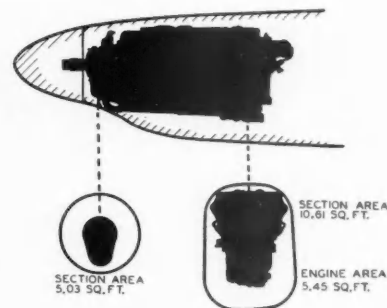
(Continued from page 27)  
'raging' stage until 2000 hp. air-cooled engines had become available. Comparison of current production models with experimental airplanes which have not gone through their 'shake-down' tests naturally favors the latter.

*Model "C" installation in airplane modified from radial type*

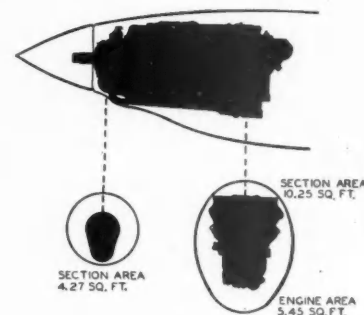
It should also be apparent that since large horsepower airplanes must weigh more, cost more, and use more fuel fewer of them can, therefore, take the air to do a job. This precept conflicts with the basic war-time idea of 'getting there fustest with the mostest men.'

**PATENTED MOULDING PROCESS IS A STERLING EXCLUSIVE . . .** Only Sterling and Sterling licensees can produce pistons by the special moulding process that was developed by Sterling's engineers. This exclusive process produces better pistons, faster and with greater uniformity.

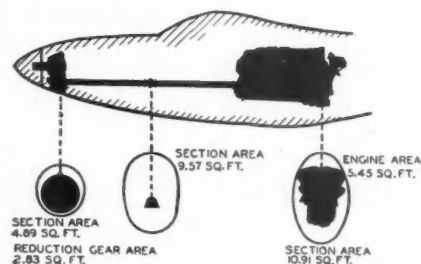
**STERLING ALUMINUM PRODUCTS, INC.**  
SAINT LOUIS



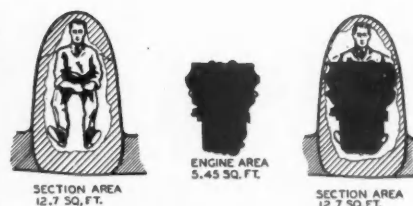
*Model "F" installation in airplane*



*Model "F" installation in airplane*



*Model "E" installation in airplane*



*Side and frontal areas of a standard pilot*

## Labor Disputes

(Continued from page 47)

an additional 5 cents in Sept. "if conditions warrant"; Continental Motors Corp., Muskegon, 5 cents and a \$30 bonus; Zenith Carburetor Division of Bendix, 7½ cents; Arvey Corp., Detroit, 5 cents.

Negotiations carried on before the Defense Mediation Board resulted in the highest wages in the West Coast aircraft industry for 11,000 employes of North American Aviation, Inc. Wage increases will total \$7 millions. The contract provides for a blanket 10-cent an hour increase, 75-cent minimum for employes with 3 months' seniority, 40 hours vacation pay for those with one year or more seniority.

Other recent wage raises in the aircraft industry include increasing the minimum from 50 to 55 cents at Consolidated Aircraft Corp., San Diego, Cal., and a modified union shop for 14,000 men; a 10-cent per hour raise to 7700 workers at the Bell Aircraft Corp., Buffalo, amounting to \$1,225,000; a 5 to 15 per cent pay increase at Sperry Gyroscope Co., Brooklyn, for 6000 employes; and a \$70,672 bonus to 2398 employes of the Republic Aviation Corp., Farmingdale, N. Y.

## What the Industry Is Doing

(Continued from page 39)

pared with increased costs of \$27.55 per car.

The industry accepted as a hopeful sign the action of the House in raising the Federal excise tax on new passenger cars from 3½ to 7 per cent, rather than the 15 to 20 per cent that had been advocated in some quarters. The Treasury Department asked a 15 per cent tax as the bill went to the Senate. The \$5 Federal license fee inserted by the House was viewed as a sop to the revenue raisers in lieu of a bigger excise tax.

Production for the week ending July 12 was estimated at 120,000 units. General Motors divisions, still operating at near-capacity, turned out 55,400 vehicles, while Chrysler slacked off a bit to 23,800 units. Ford accounted for 28,500 cars and trucks. Studebaker and Packard were the only independents still in production, the others having closed down for changeover. The third week in July was expected to see a further drop in output.

According to advance reports from 99 principal cities, new passenger car registrations for June in the U. S. were 31 per cent ahead of June, 1940, indicating an eventual registration of 415,000 units in the month. This showed a seasonal decline from May figures.

June production in the U. S. and Canada was estimated at 552,700 units by the Automobile Manufacturers Association, the biggest for any month since April, 1937, when output was 553,231 vehicles, and a 52 per cent advance over June, 1940.

# FASTER *More Efficient* LIFTING

- Release Men for Other Work
- Increase Plant Capacity

with



## CURTIS AIR HOISTS

A tough problem — Insistent pressure for increased output in the face of a shortage of skilled labor. The solution — Install a CURTIS One-man Air-Power Hoist and release some men for other jobs and at the same time make the lifting job faster and easier; also more efficient by reducing man fatigue.

Illustrated above is a large automobile manufacturing plant that uses CURTIS Air Hoists to lift and place motors on testing blocks. This continuous heavy duty job is now a fast, easy, one-man operation.

CURTIS All Steel Air Hoists are smooth in action, speedy, and efficient. They provide extreme accuracy of control and will handle the most delicate hoisting operations. Any workman can operate them — the hoist does all the work by air power. Dead weight is extremely low, allowing light supports as well as easier moving of trolley mounted loaded hoists. Available in pendant, bracketed and rope compounded types. Cannot be damaged by overloading and are unharmed by steam, fume or dust-laden atmospheres.

For complete information as to how you can step up production and lower costs in your plant, send for free booklet "How Air is Being Used in Your Industry" — mail coupon today.

# CURTIS

St. Louis      New York  
Chicago      San Francisco  
Portland

CURTIS MANUFACTURING COMPANY  
1917 Kienlen Avenue, St. Louis, Missouri

Please send me your free booklet "How Air is Being Used in Your Industry" and further details concerning Curtis Air Hoists.

Name.....

Firm.....

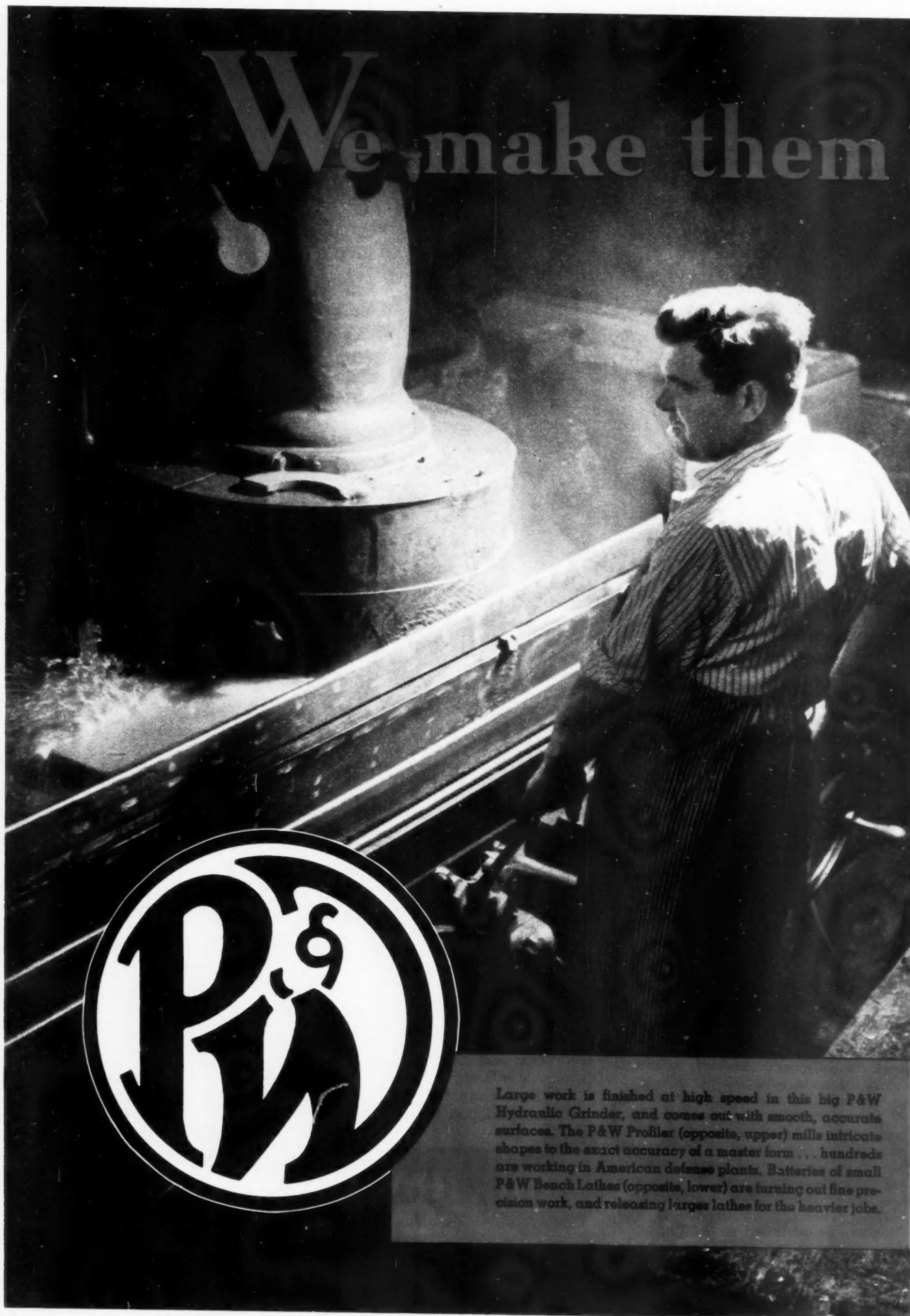
Address.....

City.....

State.....



# We make them

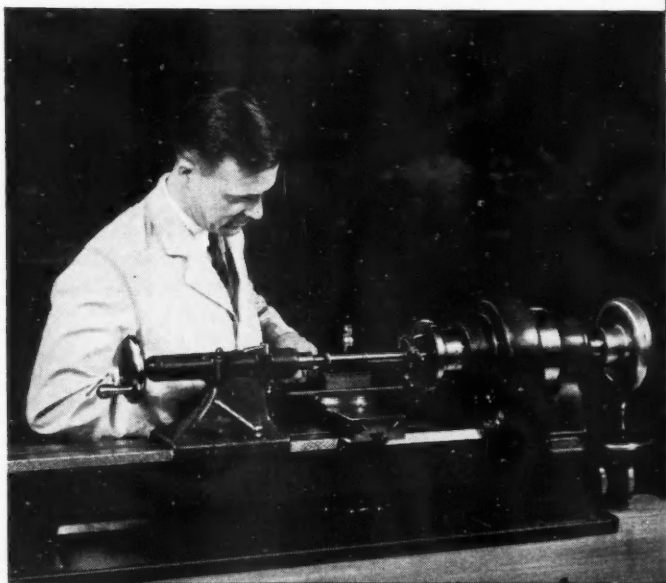
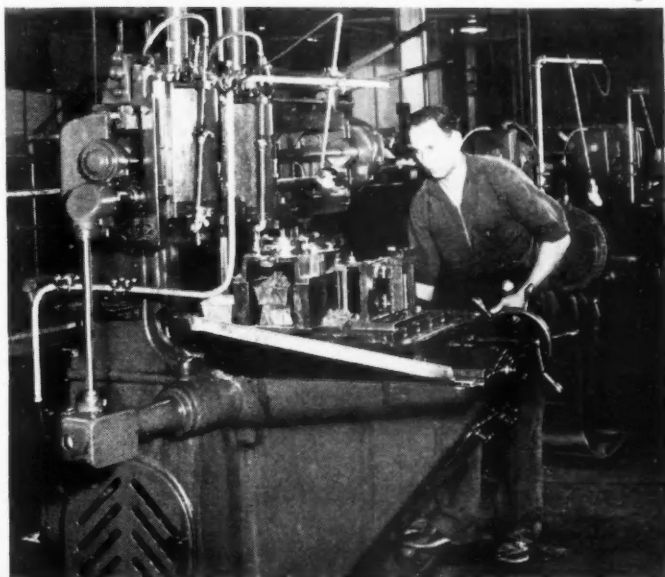


Large work is finished at high speed in this big P&W Hydraulic Grinder, and comes out with smooth, accurate surfaces. The P&W Profiler (opposite, upper) mills intricate shapes to the exact accuracy of a master form . . . hundreds are working in American defense plants. Batteries of small P&W Bench Lathes (opposite, lower) are turning out fine precision work, and releasing larger lathes for the heavier jobs.

# accurate . . . *but tough*

*They'll roll day and night*

*E*mergency demands all over the U. S. have proved Pratt & Whitney quality beyond any possible doubt. The performance records in hundreds of plants working 24-hour schedules on national defense show that the hours of careful, painstaking work in our plant were well spent. Pratt & Whitney machine tools are rolling night and day . . . smoothly, accurately, at full production speeds.



The measure of any machine is its ability to rapidly and accurately remove metal, and stay on the job. Pratt & Whitney craftsmanship has put that quality into every P&W machine tool. Production men never need hesitate to push them to the limit. They are accurate . . . but tough. Ask our sales engineers to check with you to be sure your Pratt & Whitney equipment is turning out all it is capable of doing. Our men are ready to help you any time . . . anywhere.

## PRATT & WHITNEY MACHINE TOOLS

Pratt & Whitney, Division Niles-Bement-Pond Company, West Hartford, Conn., U. S. A.

# MEN and MACHINES

(Continued from page 45)

Inasmuch as the new guide vanes are an inherent part of the pump bowl assembly, an owner of a vertical turbine pump does not need to purchase a complete new pump in order to take advantage of the new design. It is only necessary to substitute a new bowl assembly. (Illustrated on page 44.)

**F**OR marking around the circumference of rough forged or finished shells, M. E. Cunningham Co., Pittsburgh, Pa., now makes Shell Marker No. 1, a motor driven machine which is available in either pedestal or bench models.

The marking die is made to take either individual interchangeable type

or solid stamp inserts. Both the die and inserts are constructed from special safety steel to assure the maximum of service and safety. The marking die rotates continually, thereby eliminating need for clutch and speeding up production. A red and green colored plate on outside of rotating shaft indicates when the die is in position to allow insertion of shell. It is geared to stamp a maximum of 18 shells per min.

**A**IRLOX JUNIOR PNEUMATIC VISE is a new addition to the Airlox line of Production Devices, Inc., East Hartford, Conn. It is a precision built, production tool, powered by a special Schrader air cylinder which, with the mechanism, is enclosed inside the vise body. Air consumption is specified at 0.005 cu. ft. per operation. The gripping force is given as approximately 20 times air line pressure during last 1/16-in. of jaw travel. The jaw size is 4 1/4 in. wide by 1 7/16 in. deep.

**P**RECISION SCIENTIFIC CO., Chicago, announces a new electric stopwatch, known as "Time-It" Minute Model, run by a synchronous electric motor, which operates a direct reading indicating counter. Accuracy is covered by the cycle constancy of 115-volt A.C. current supply. The device integrates to 1000 min., reading in full minutes and hundredths of a minute. It can be reset to zero from any reading, or successive readings can be totaled. Applications include laboratory procedures, time study operations, and motor dynamometer tests.

**H**ARRIS SOAP CO., Buffalo, N. Y., has introduced a spray booth coating, Boothcote, for reducing the cleaning operation time to a few minutes. The process is a simple one. Boothcote is sprayed on the clean metal walls of the spray booth. Then waste paint, lacquer, or enamel, is allowed to accumulate, after which the whole mass of waste paint is removed in a large sheet, or in as large a sheet as a man can handle. Another rapid coating of the metal walls and the booth is ready to be used again in production.

**F**OR use on any normal-duty application that would otherwise require fuses or fused switches, a new low-cost multi-breaker is announced by Westinghouse Electric & Mfg. Co. Available in two types, M-1 and M-2, these 15 to 100 amp., 2 or 3 pole breakers are for use on a.c. circuits up to 230 volts. In operating, a bimetal thermal element is actuated by overload or short circuit and causes the breaker to trip. However, while the breaker trips immediately on short circuit or dangerous overload, an inverse-time characteristic allows it to remain closed during temporary harmless overloads. An indicating target on the enclosure cover shows when multi-breaker has tripped.

## Save WEEKS of Delivery Time on Many of Your CARBOLOY TOOL REQUIREMENTS

... and also reduce your tool cost!

### Vital Facts About Carboloy STANDARD STOCK Tools & Tips!

Here are three ways in which you can obtain your Carboloy tool requirements in the fastest, most efficient and most economical way under present conditions:

- 1 Use Carboloy Standard Stock Tools. These are made in "mass production" quantities and are stocked and shipped by the thousands each week. You always get them faster than "specials". A check-up of your Carboloy tool needs will reveal many that can be easily changed over to standards. You save weeks of delivery time.
- 2 Use Carboloy Standard Blanks. These, too, are made in "mass production" quantities. If a thorough check reveals that you can't use Carboloy Standard tools (most users find they can), ask your tool designers to incorporate Carboloy Standard Blanks in their special tools whenever possible. This saves production time.
- 3 For emergency tooling braze your own Carboloy tools. Many users keep a supply of Carboloy Standard Blanks ready for emergency tooling and repairs. Many, too, braze ALL their own Carboloy tools.

Carboloy Standard Tools consist of the 10 styles shown at right, suitable for, or adaptable to, 60% to 80% of all turning, facing, boring applications. In cases where these tools, as supplied, do not exactly meet design requirements, you will find your tool room can usually grind variations to meet a wide range of special angles and shapes.

Generously sized Carboloy tips, plus modern rapid Carboloy grinding technique, make this procedure practical and fast. By this method you can take advantage of the greater economy and faster delivery of Carboloy Standard Tools—often WEEKS faster than "specials"!

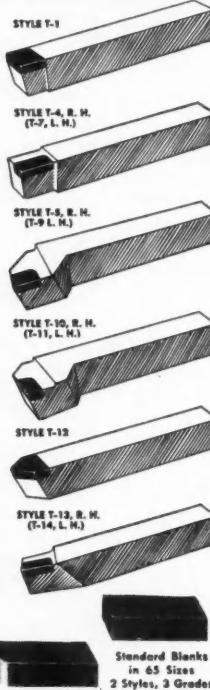
Carboloy Standard Blanks, too, save time and money. Two styles (shown lower right) available in 65 sizes, three grades.

A few minutes spent to get the facts about Carboloy Standard Stock Tools and Blanks may save you weeks of delivery time. Send for Catalog GT-129.



CARBOLOY COMPANY, INC., 11151 E. 8 MILE ROAD, DETROIT, MICH.

Chicago • Cleveland • Los Angeles • Newark • Philadelphia • Pittsburgh • Worcester, Mass.  
Canadian Distributor: Canadian General Electric Co., Ltd., Toronto, Canada



# CARBOLOY

STANDARD  
TOOLS & TIPS

"You ALWAYS Get Standards FASTER Than 'Specials'!"

CATALOG  
GT-129

SEND  
FOR FREE  
CATALOG



# Automotive Materials

(Continued from page 46)

ment over conventional lead-base and tin-base babbits that there is said to be little question that bearings made of the new alloy have improved fatigue resistance.

Bearings made of the new alloy have been installed on several automobiles and in machinery, and although several of these tests have now run over 18 months, no failures have been experienced to date.

## Powder Developed for Eliminating Static Shock

**R**ADIO static interference in automobiles and static shock caused by the friction of rotating parts, such as wheels and fan belts, can be eliminated by application of its newly-developed powder, the United States Rubber Co. announces. It will be marketed under the trade name U. S. Automotive Static Neutralizer.

For automobile application, tires are deflated, valve cores removed, powder blown into the tubes with an applicator, and tires inflated. Loss of powder in case of a puncture is said to be so negligible that full effectiveness remains.

Of the various factors influencing static electricity in automobiles—such as atmospheric conditions, clothing and car upholstery, road surfaces, and moving parts of the car—the tires seem to be the only one that contributes doubly, since they not only build up electricity through friction against the road, but also insulate the car from the ground.

## Plastic Coating That Stays White

**W**HITE instrument dials that are not discolored by high temperature, light, chemical fumes, or moisture are being made at the Westinghouse Meter Division, Newark, N. J., by means of a recently developed liquid plastic material, which is sprayed on metal much the same as lacquer or paint would be.

In typical tests previous white lacquered dials changed to a light coffee brown after 10 hours of exposure to dry air at a temperature of 317 deg. Fahr. Fumes from heated raw phenolic plastics changed white to straw color after 120 hours, and a saturated sulphur dioxide atmosphere mottled dials with yellow splotches after 100 hr. Under identical test conditions the new plastic-coated dials were practically unchanged.

Metal stock used for dials must be of a special type and the surface must be carefully prepared to provide proper adherence for the plastic coating, which is hardened on the surface by quick heating and then dried com-

pletely by controlled baking in an electric oven. After coating, dial faces are lithographed on a special press.

## Oakite Deodorant No. 1 is Triple Action Material

**O**AKITE PRODUCTS, INC., New York City, has announced a new product, Oakite Deodorant No. 1, which

has been compounded to combine detergent action, disinfecting and deodorizing properties in one material. It is intended for use in factories to solve large scale sanitation problems. Dirt, oil or grease is said to be removed easily from cement, tile or porcelain surfaces, leaving them odor-free.

## Security Metal Products Co.

Offices and plant of the Security Metal Products Co., Inc., manufacturers of Security locking nut, have been moved from Kalamazoo to Saugatuck, Mich.

**"I WANT THE BEST POSSIBLE JOB - I MUST HAVE A GOOD OIL!!"**

**"THAT'S WHY I CALLED THE CITIES SERVICE LUBRICATION MAN IN" SAYS A. E. DAVEY, PRESIDENT OF ALLOY STEEL GEAR AND PINION COMPANY OF CHICAGO.**

"I'm doing a job here that must be perfect when it leaves the shop. The people who get the gears are plenty critical." Mr. Davey says further, "I don't know everything about oil. That is why I called in the Cities Service Lubrication man.



A. E. Davey

I expect him to work with my men to see that they get the oil best suited for the job."

Much work in this shop must meet rigid government inspection.

All Gleason, Fellows Gear Shapers, Lee Bradner and Brown & Sharpe machines, are operated with Cities Service Lubricants. You, too, will find these high-quality fluids capable of doing the kind of work your customers want.

Call us in for consultation — there is no charge for the service. Write us on your letterhead or mail the coupon for a copy of our booklet, "Metal Cutting Lubrication."



**FREE**  
Just clip  
and mail

**CITIES SERVICE OIL COMPANY**  
Sixty Wall Tower, Room 1329, New York

Please send me a copy of your booklet, "Metal Cutting Lubrication."

Name.....  
Firm Name.....  
Address.....  
City.....State.....

# BOOST PRODUCTION



The regular HOLTITE line comprises a complete range of screws, bolts and allied fastenings

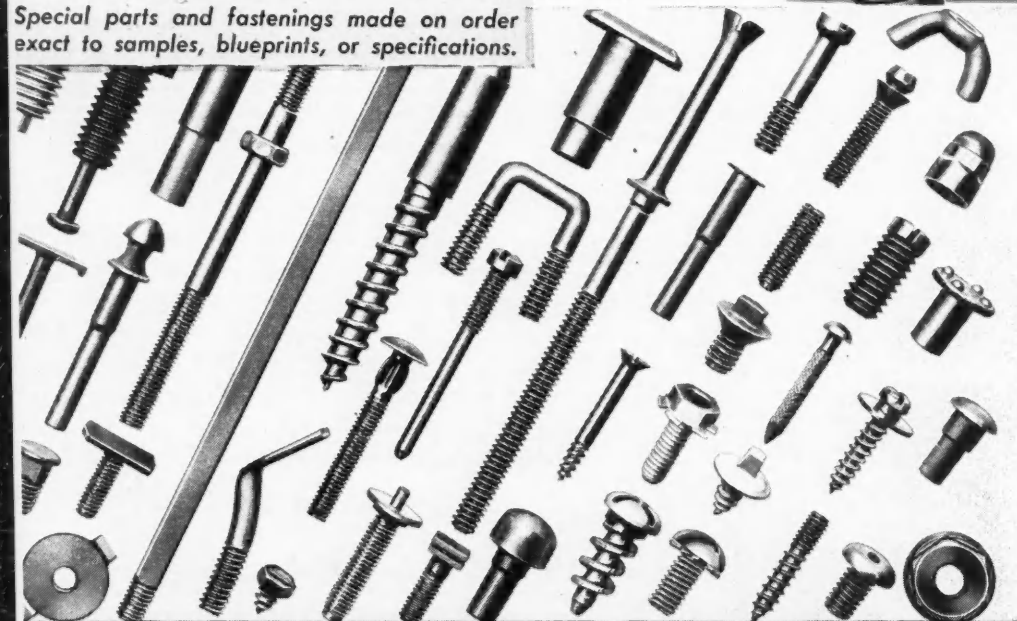
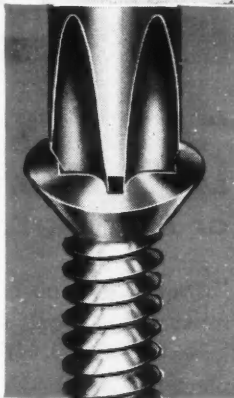
- For smooth, uninterrupted production specify HOLTITE fastenings. By eliminating bottle necks in assembling operations these uniform, durable fastenings speed up production and insure delivery on time! Strength far beyond ordinary demands, tested accuracy and uniformity, rigid inspection—all combine to insure dependable performance.

- For maximum efficiency and economy, specify HOLTITE on your next fastening order. There's a HOLTITE product for every fastening requirement—regular or special.

Special parts and fastenings made on order exact to samples, blueprints, or specifications.

## HOLTITE —Phillips— Recessed Head Screws & Bolts

By cutting assembly costs up to 50% and more, these modern fastenings are now used by every manufacturer interested in reducing assembly time, costs, spoilage and injuries.



# CONTINENTAL SCREW COMPANY

New Bedford, Mass. Warehouses at Detroit, Chattanooga

## Thiokol Production at 500,000 Lb. per Month

To take care of the increasing demand for Thiokol synthetic rubber, Thiokol Corp. and the Dow Chemical Company have opened a new plant in Midland, Mich. The new plant has a capacity of 150,000 lb. per month and will increase the aggregate capacity for the production of Thiokol to 500,000 lb. per month.

## Dutton-Lainson Co.

Products of the F. Jaden Mfg. Co., as well as all the products of the Frank Rose Mfg. Co., which for many years has been the manufacturing division of the Dutton-Lainson Co., Hastings, Neb., will be made and sold under the latter's name. The company name of the former W. M. Dutton & Sons was changed to the Dutton-Lainson Co.

## Metal Supplies

(Continued from page 54)

prices grants to mills small advances on some gages of strip steel through reclassification of cold rolled. Permission to include in their delivered prices actual freight costs, instead of the lowest published common carrier freight rate, has also helped some steel producers.

Price Administrator Leon Henderson has informed Michigan copper producers that the problem of a price sufficiently high to enable high cost producers to maintain current production is not to be confused with that of a special premium for any increase over present production in order to stimulate increased output. Some sort of announcement regarding copper prices overhangs the market, the impression in the trade being that regardless of what subsidies may be granted to high cost producers, a uniform maximum price, probably 12 cents a pound, will be decreed. Custom smelters have been quoting 12½ cents.

## Materials Under Government Control

OPM's priorities division has placed chromium on the industry-wide mandatory control list that includes aluminum, magnesium, nickel, nickel steel, ferro-tungsten, tungsten high speed steel, machine tools, synthetic rubber, copper, cork, borax, polyvinyl chloride, zinc and rubber.

In addition the priorities division now exercises inventory control over antimony, cadmium, cobalt, all types of ferrous alloys, iridium, iron and steel products including rolled, drawn, forgings, castings, and pig iron, lead, manganese or spiegeleisen, mercury, molybdenum, all types of non-ferrous alloys, tin, vanadium, secondary materials or scrap containing any of the metals listed or any metals already subject to an order of the Director of Priorities, prepared for sale in order to recover the metal content.







# Photoelasticity in Automobile Engineering

(Continued from page 38)

can be grouped fillets, tapered and serrated joints, splines, cotter pin holes, keyways, miscellaneous grooves and, in general, shafts of varying diameter.

In shafts of varying diameter, such as crankshafts and camshafts, the main problem is to avoid excessive stresses at the fillets. The general fillet problem has been the subject of many investigations in the past 20 years and the literature is abundant both in experimental and theoretical data.

Impact stresses in an automobile come from two main sources: (1) Loads due to road shocks, and (2) loads due to shocks which arise when wear causes increased clearance between parts of the assembly, such as the transmission, the steering gear or the rear axle.

In service, the first type of force occurs not only when the suspension bottoms against the frame, thus impressing a shock, but also when it operates within its normal range.

The second type is being studied in our laboratories by means of strain gages and a cathode-ray oscillograph. Test data indicate that in the steering gear impact stresses caused by wear are negligible.

In the study of such transient phenomena photoelasticity is facilitated by use of a high speed camera coupled with a high intensity stroboscopic light source, such as has been developed by Edgerton for the investigation of crack propagation in glass.

Certain miscellaneous stress problems not covered by the above three headings can also be effectively studied by photoelastic method.

For example, knowledge of thermal stress distribution is of particular importance to the engine designer. Certain phases of this problem have been effectively treated by mathematical analysis, but the general problem of long hollow cylinders with non-uniform cross-section, such as encountered in automobile engines, still remains unsolved.

Photoelastic study is of particular value in the following automotive problems:

1. The problem of wall cross-section in engine manifold.
  2. Piston out-of-roundness and its relationship to temperature changes.
  3. The design of a cylinder head hold-down bolt with uniform stress distribution.
  4. Thermal stresses in fluid coupling caused by engine and fluid friction heat during the idle period.
- Inclusions in rubber subjected to a load represent another problem of considerable interest to the automotive engineer. The subject divides itself into two phases:

- a. Rigid Inclusions.
- b. Microscopic Inclusions.

The first pertains to metals, as for example, in the crankshaft damper. Microscopic inclusions deal with filler particles which often give rise to complex stress distributions. For these problems theoretical treatment is very difficult.

The above classifications, based on types of loads to which the part is subjected, give an accurate picture of the diverse application of photoelasticity in the automobile industry. In the laboratory, however, for the actual solution of these problems, a different classification is found to be more effective. In this grouping the principal criterion is the *objective* of the problem, that is, whether the study involves only comparison of designs or a thorough investigation of the stress pattern in all its aspects.

Comparative studies determine if one type of fillet has more nearly uniform stresses than another, whether one thread design results in a stronger or a weaker fastening, or if an introduction of cooling fins in a given section would create an undesirable stress concentration. Such comparative determination of stresses demands simple photoelastic technique which by now is

CLOSE TOLERANCES WITH

# Thomas Strip

COLD ROLLED  
STRIP STEEL

**T**HOMAS mill operations are maintained at an unusually high peak of perfection. Prominent among these is slitting, which has proved of vital importance to many customers. The edges of Thomastrip are straight, and the width is accurate throughout the coils, enabling free and unhesitating production through progressive and other types of stamping or forming dies. The original edges of Thomastrip are often utilized in finished products without further touching up during assembly operations. Because of these slitting qualities, Thomas customers reduce their manufacturing costs.



Always Laboratory Approved

**BRIGHT FINISH  
UNCOATED AND  
ELECTRO COATED  
WITH NICKEL,  
ZINC, COPPER, BRASS**

**THE THOMAS STEEL CO., WARREN, OHIO**  
SPECIALIZED PRODUCERS OF COLD ROLLED STRIP STEEL

fully developed and universally known.

Absolute studies involve a determination of the total stress pattern. This is necessary because the studied part being new or the conception being original no standard for comparison exists.

From the academic point of view both the sum and the difference of principal stresses must be determined, so that the stress distribution inside the body, as well as at the free boundary, is fully known.

From the practical point of view, the numerical value of the free boundary forces fully represents the working stress in an automobile part, with a possible exception of contact phenomena. This is due to the fact that the maximum stress is almost always at the boundary, whether inside or outside, and in addition, "stress raisers," such as notches, fillets, etc., which are responsible for stress concentration are also located only at the free boundary.

Therefore automotive problems involve the determination of principal boundary stresses and these can be measured very effectively by means of photoelasticity without any other engineering method.

## More About the Daimler-Benz Engine

(Continued from page 35)

cessories-drive housing are taken the camshaft drives and those for the coolant and oil pumps. A number of ball bearings support the various drive shafts and gears. Gears are ground, including the bevel gears.

The reduction gear for the propeller, which is of the simple spur type, is shown in Fig. 8. Both gears of the set are carried on roller bearings. On the left is shown the splined sleeve which connects the pinion to the crankshaft. The width of face is  $2\frac{1}{2}$  in. Both gears are ground and have the edges of teeth carefully rounded. The cast-aluminum gear case is internally ribbed for strength. An oil feed line, ending in a jet with two  $1/16$ -in. holes, squirts oil on the teeth as they come out of mesh.

Fig. 9 shows the Bosch dual magneto used for ignition, which is enclosed in a light aluminum housing. It is of the inductor type and comprises a star-shaped rotor shown in the photo. Two cylindrical condensers are mounted on the inside of the endplate.

## Airplane Wheel Production

(Continued from page 23)

have had most satisfaction with a soluble oil mixture of 30 parts of water to 1 part of the soluble with soda to soften the water.

To provide a better visualization of the work in this department, we have reproduced a selected group of illustrations which, together with the descriptive captions, should reflect the major aspects of the overall activity.

★  
**GUARDING  
QUALITY  
THAT  
LIBERTY MAY LIVE**  
★



War machines and munitions have to be good to stand up under war conditions. They must be made rapidly in huge quantities by a variety of plants. All parts must be strictly interchangeable.

Hence the task of guarding quality becomes a matter of life and death importance to a nation rearming to preserve its liberty.

Sheffield Visual Gages are stalwart guardians of dimensional quality. They are used in checking dimensions of manufactured and purchased parts, tools, production and master gages.

The sturdy Reed Mechanism, combined with the light beam lever arm, provides a sensitivity to meet the highest precision standards of measurement—but without the delicate fragility so often associated with sensitivity.

These gages are not delicate, they are strong and deadly accurate. They are made in various models to check accurately to thousandths, "tenths" or millionths of an inch and all provide rapid, easy gaging to any limits required on production work.

Write for information.



THE **SHEFFIELD**  
CORPORATION  
*Gage Division* • DAYTON, OHIO, U.S.A.



## Testing Army Airplanes

(Continued from page 25)

and on the ground.

In addition there are tests of air intake and exhaust systems, carbon monoxide tests, radio interference, armament, navigation instruments, and night tests of lighting equipment.

Routine flight tests of new development equipment are being made constantly at Wright Field by project officers as well as test pilots. In the equipment flight tests, the project officer is interested primarily in recording the functioning of new equipment

under maximum operating conditions. Air Corps equipment is developed in a group of laboratories at Wright Field. Experimental equipment is fabricated only when it cannot be obtained commercially without undue delay.

Requests for routine flight tests of equipment originate in the Production Engineering and the Experimental Engineering Sections. Some of the latter's laboratories contain laboratories within laboratories.

The Power Plant Laboratory, for instance, consists of 25 units, each specializing in the various components of an aircraft engine, such as ignition, carburetion, cooling systems, etc., and

enormous dynamometer and torque stand laboratories are included in this organization.

The Aircraft Laboratory, in addition to aerodynamic, design, flutter study and other units, includes two wind tunnel laboratories, a giant high-speed wind tunnel in construction, a brake-tire-wheel testing laboratory, and a large structures laboratory.

Similarly, laboratories within laboratories are necessary in the Photographic Laboratory, concerned with the development of new lens, emulsions and cameras used in aerial photography; in the Equipment Laboratory, where aero-medical research, parachutes, oxygen equipment, navigation instruments, airdrome equipment and scores of kindred development projects are directed; the Propeller Laboratory with huge outdoor test rigs; the Armament Laboratory with its firing range. All are intricately organized.

## PERFORMANCE SCIENTIFICALLY CONTROLLED



**MORSE CHAIN COMPANY**  
ITHACA, N. Y. DETROIT, MICH.  
Div. Borg-Warner Corporation

Behind the Morse Silent Timing Chain lie years of continuous field and laboratory research to make materials and design meet the most exacting demands of tomorrow's motor car. For smooth, quiet timing chain performance, investigate Morse—the Silent Timing Chain used in the majority of chain-equipped cars.

# MORSE

## SILENT TIMING CHAINS

## Explosive Rivets

(Continued from page 31)

improved, and equipment for loading the rivets with accurate amounts of the explosive had to be developed.

Finally, in the fall of 1940, after they had been tested and evaluated by the United States Army and Navy, the improved du Pont rivets were sold in limited numbers to a few aircraft manufacturers for further testing and actual shop installations. These rivets were made on experimental tools, but were loaded on production equipment.

One of the illustrations shows the du Pont rivet, in both the original and installed condition. Prior to installation, the rivet is similar to a solid rivet, except for the cavity which is concentric with the shank and open at the shank end. The cavity holds the small explosive charge which, when heated to a certain temperature, detonates and expands the shank end uniformly without cracking. The rivet to the right in the illustration shows the shape of the shank after expansion. Due to the nature of the explosive, no confinement (no wadding) is required.

The heat necessary is supplied by an electric tool with a silver tip, known as the du Pont riveting iron. The application of the iron to the die-formed head of the rivet is shown in Fig. 2. It takes from 1½ to 2½ sec. from the time the du Pont riveting iron is applied until expansion takes place.

The rivets now being manufactured are of an aluminum alloy, and they come in various diameters and lengths to meet structural requirements. They are of the modified brazier-head and countersunk types, the latter permitting the flush-riveting required by modern high-speed planes. Rivets are installed in the "age-hardened" condition and do not require refrigeration after heat treatment. In shear and tension they are said to be approximately equal to the driven rivets now widely used.